ELECTRICAL CONSTRUCTION AND MAINTENANCE

JANUARY · 1948

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Conduit Sizes for Signal Systems . page 56
Drafting Room Lighting Techniques . page 59
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fluorescent ballasts

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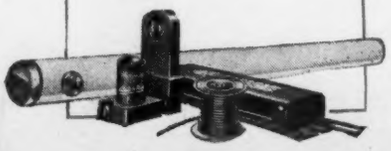

GENERAL ELECTRIC

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

With which is consolidated Electrical Contracting, The Electragist and Electrical Record . . . Established 1901

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering installations, repairing, maintenance and management, in the field of electrical construction and maintenance.

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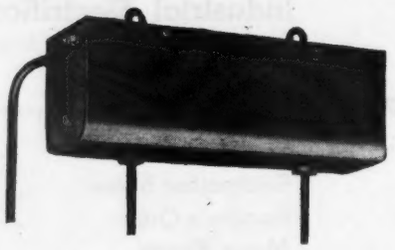

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ELECTRICAL CONSTRUCTION and MAINTENANCE. Published monthly. Price 35 cents a copy. Vol. 47, No. 1. Allow at least ten days for change of address. RETURN POSTAGE GUARANTEED. Publication office, 99-129 N. Broadway, Albany 1, N. Y. All communications about subscriptions should be addressed to J. E. Blackburn, Jr., Vice-President (for Circulation Operations), Electrical Construction and Maintenance, 330 West 42nd St., New York 18, N. Y. Subscription Rates—U. S. and possessions, $3.00 a year, $4.00 for two years, $5.00 for three years. Canada $4.00 a year, $6.00 for two years, $8.00 for three years. Pan American countries $6.00 for one year, $10.00 for two years, $12.00 for three years. All other countries $15.00 a year, $30.00 for three years. Please indicate position and company connection on all subscription orders. Entered as second class matter August 29, 1936, at Post Office, Albany, N. Y., under the Act of March 3, 1879. Printed in U. S.

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"The fate of the world sits on this rug"

—JOHN L. LEWIS

NOTE: Paste this editorial in your hat. Re-read it as you start to shiver the next time John L. Lewis cuts off the nation's coal supply.

"Labor monopoly" will mean much more to you then. But if you are worried enough you will get after your Congressman to do his part now — before the shivering starts.

★ ★ ★

"The fate of the world sits on this rug."

The men on the rug: John L. Lewis, President of the United Mine Workers, who made the remark; Benjamin Fairless, President, United States Steel Corporation; George M. Humphrey, Chairman, Pittsburgh Consolidation Coal Company; Harry M. Moses, President, H. C. Frick Coke Company; Charles O'Neill, President, United Eastern Coal Sales Corporation; the late John O'Leary, International Vice President of the United Mine Workers; and John Owens, President, District No. 6 United Mine Workers.

The place: Room 800, Carlton Hotel, Washington, D. C.

The time: Last July during the "negotiation" of a new soft coal contract.

The outcome: Another whopping increase in wages and the price of coal, another hike in the cost of living, and a "contract" which binds the United Mine Workers only as long as they are "willing and able to work."

Mr. Lewis was right. The fate of the world did sit on the rug. In fact, it sat at Mr. Lewis' feet, for, as this editorial will explain and as the outcome shows, his power over coal is absolute.

Without coal modern industrial civilization collapses. Without Mr. Lewis' assent coal can not be mined. He has the nation and, in the years 1947-48, the world at his mercy.

The Taft-Hartley Act, good as it is, does nothing to check this kind of monopoly.

I

The Taft-Hartley Act fails to protect the public in many major particulars.

Here are some of them.

1. Labor monopoly is promoted and protected by its continued exemption from the federal antitrust laws. Management has no such exemption and should not have.

2. Industry-wide bargaining, a kind of second-degree monopoly, is left virtually undisturbed. So is union-wide bargaining which extends the power of national unions far beyond a single industry.

3. Featherbedding, the art of getting paid for doing nothing, is left largely intact.

4. The menace of having local utility strikes wreck the health and safety of a community is left untouched. Postponement and persuasion are the only instruments provided to deal with strikes that would wreck the nation.

My purpose in citing these omissions from the Taft-Hartley Act is not to belittle the act or its framers. They did a most courageous and constructive job. They made a real start toward restoring a workable balance in industrial relations in the United States, so far as the law can do it. But they have not completed the job. Among their omissions the two discussed in the next sections of this editorial stand out above all others.

II

The most serious Taft-Hartley shortcoming is its failure to deal with labor monopoly.

Labor monopoly exists wherever a union is so strong that bargaining becomes a sham and the union virtually dictates its own terms.

If an employer or group of employers secures a monopoly or anything approaching a monopoly, prosecution for violation of the federal antitrust laws

is in order. That is as it should be, for monopoly means death to economic and political freedom.

But if a labor union secures complete monopoly control over an industry through control of its workers, that union remains above and beyond the antitrust laws. "The fate of the world sits on this rug." By that imperial attitude John L. Lewis fully demonstrated how obsolete is the notion that labor unions are weak and, therefore, need exemption from the antitrust laws. Through the United Mine Workers, Mr. Lewis controls about 90% of the coal miners. (No company controls more than 5% of the nation's coal output.) Wherever he sits he has at his feet the welfare of the whole nation.

Great international unions exercise a comparable measure of monopoly control in other basic industries — steel, transportation, and automobiles, for example.

These labor monopolies can destroy the nation if they are not themselves broken up. Witness the plight of France. There the Communists have found in the great labor monopolies an instrument for shaking the nation to its foundations.

III

The Taft-Hartley Act also leaves untouched industry-wide collective bargaining, which is a kind of second-degree monopoly.

When all or almost all of the employers in an industry get together with the union leaders to agree on wages and working conditions (that is called industry-wide bargaining) they set up a monopoly control. It is a less concentrated monopoly than when the terms are dictated by either side, as Lewis dictates them in coal. But, nonetheless, competition is eliminated and monopoly control is established over wages, which are by far the largest element in the cost of production. It follows that public regulation of collective bargaining — *which means the end of free unions and free management* — is not far behind.

Some employers defend industry-wide bargaining as their only defense against industry-wide unions. Other employers like it because it makes wages and hours uniform for their whole industry.

For those employers who are forced into industry-wide bargaining in self-defense the road to relief is clear. Congress owes it to them and to the public to free them from the necessity of dealing with a monopolistic union. The best way to do that is to remove the exemption of labor unions from the federal antitrust laws.

To those employers who engage in industry-wide bargaining because they like it the proper answer is also quite clear. They (and the union involved) are maintaining a private monopoly which is offensive to the public interest. It should be prevented by law.

IV

Congress should finish the job of eliminating labor monopoly and industry-wide bargaining.

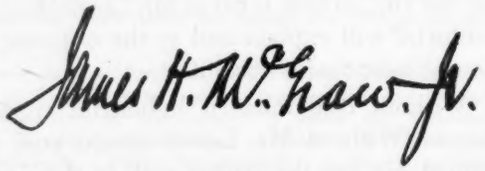
In the course of enacting the Taft-Hartley law last spring the House acted to eliminate the exemption of unions from the federal antitrust laws and to make industry-wide bargaining illegal. The Senate, however, refused to go along.

The principal reason advanced in the Senate for deferring action was that more knowledge is required to legislate intelligently. To get the needed information, a joint Congressional committee was created.

It is standard Congressional practice to stall off tackling a difficult job by creating a special committee to study it. The new joint committee is not likely to prove an exception to this rule — *unless the voters loudly demand of Congress that it get on with its job of protecting the public interest in the conduct of labor relations — a job which is nowhere near done.*

Helpful and effective as many of its provisions are, the Taft-Hartley Act does not face squarely the central principle of industrial relations in a free society. That principle is this: *Neither employers nor organized workers, separately or in combination, shall exploit the public by establishing a monopoly.*

Do not let your Congressmen go to sleep on the job of solving that problem or hide from it because of fear. The perfect solution may be hard to find. But the problem can be largely solved by making organized labor subject to the federal antitrust laws just as management is now subject to them. If that problem goes by default your children and your grandchildren will really know what slave labor means.



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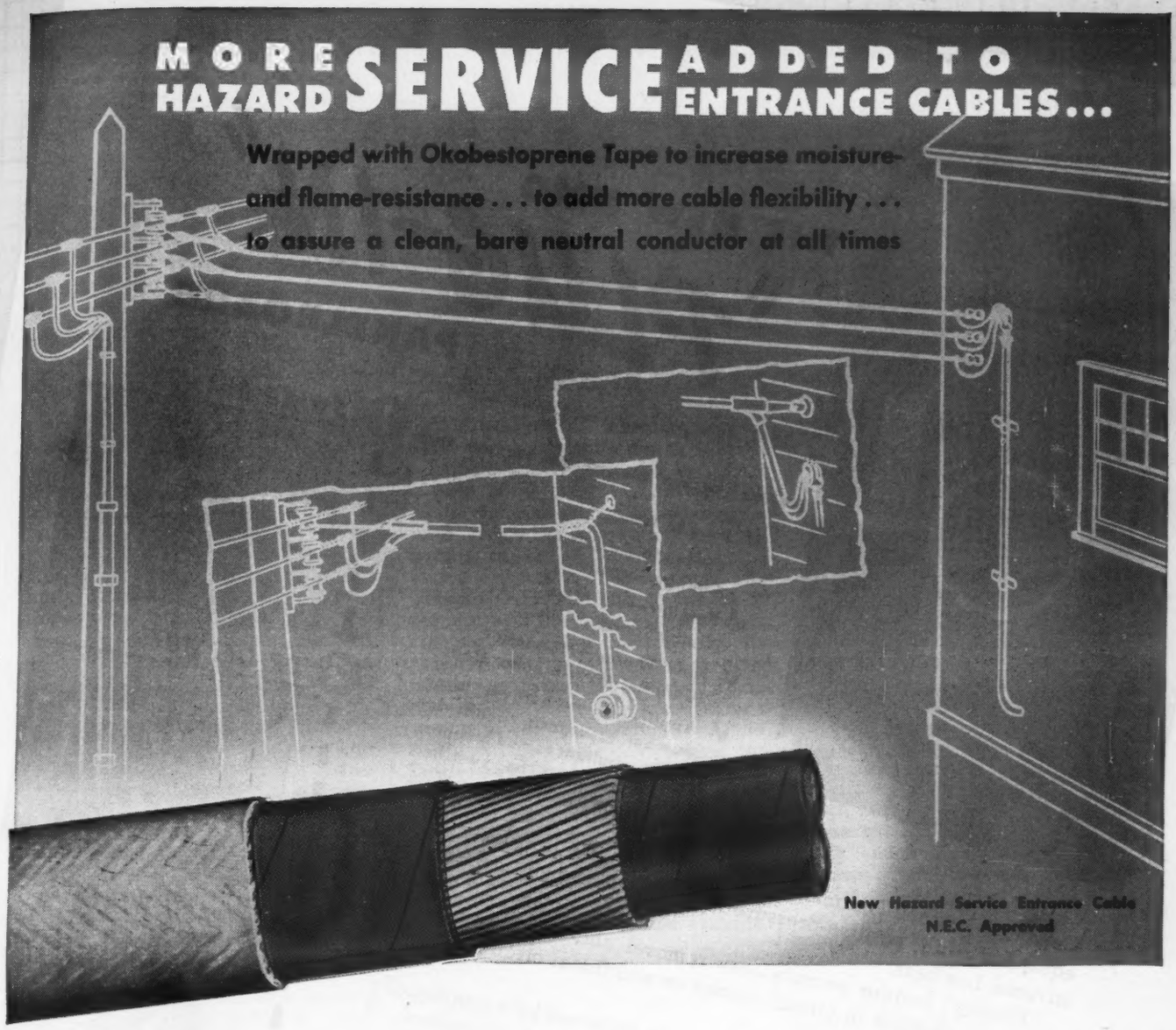

With types UBN and ABN Hazard Service Entrance Cables, black and red Okobestoprene Tapes are now wrapped over the individual insulated conductors in the place of the old style color coded braids. And another layer of Okobestoprene Tape is wrapped over the bare neutral conductor as a moisture seal and for additional outside protection.

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For further details see your Hazard supplier or write Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

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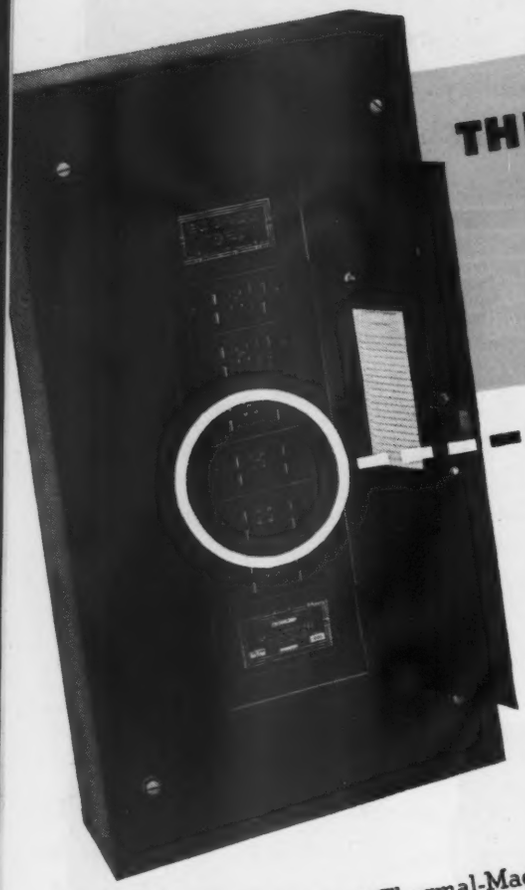

- ✓ Easy to Wire
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- ✓ New Thermal-Magnetic (Coilless) Multi-breaker Units
- ✓ Application—wherever large number of branch circuits for lights, appliances and business machines must be switched and protected.

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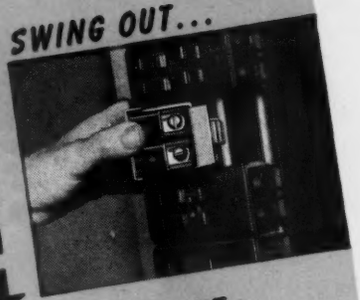

2 OR LIFT OUT...

3 ATTACH WIRES...

4 "PLUG-IN"

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"Plug-in" feature permits easy removal and insertion of units for future changes in circuit ratings or additional circuits if space for expansion is planned.

Low heating, permitting small size, is achieved by exceptionally high silver content in breaker unit contacts, and elimination of bolted current carrying connections.

Smaller size greatly improves utilization of wall and column space. Yet panel has more gutter space (5½" in 15" box) because of compact Multi-breaker unit. Narrow column type has twice number of circuits previously available in cabinets of similar height.

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JANUARY . . . . at a Glance

Biggest Year

Every year it is customary for us to assemble statistics and appraisals from many sources and project the probable pattern of next year's business. An estimator who carefully appraises conditions, takes off quantities, and prices labor materials and job expense can come up with a fairly accurate job estimate. In the same way current statistical data gives us pretty fair background for estimating next year's construction. The outlook for '48 on page 52 is just such a considered appraisal. The picture is optimistic. It seems certain that 1948 will set new records in construction volume. While the totals include some of the inevitable effects of inflation they still represent in physical volume a market of tremendous proportions for the year ahead.

Glare Elimination

One of the major problems of modern lighting is the reduction of reflected glare under modern lighting intensities. Directly reflected light, specular reflection, cuts down visibility. Increases in intensity also increases the reflected light. If such glare could be eliminated, it would be possible to greatly increase footcandle illumination with complete comfort and a comparable improvement in actual visibility. Light polarization can provide such control but conventional polarizing methods heretofore have worked only at a critical angle. A new material using radial polarization, however, may open up new horizons of light control. The polarization, the makers say, is always in a plane perpendicular to the plane of incidence. Effective transmission is claimed to be in the order of 70 percent with approximate reflector surfaces. How effectively this new material will solve glare problems is still to be proved on a full scale lighting job. Several such installations, however, are now under way. The results may have important effects on future lighting designs.

Adequate Wiring

If the electrical industry in your community is not set for an all out adequate wiring campaign in 1948, it is time to get going. In the northern states there are only a few months until spring building starts. In the warmer areas residential construction is going ahead at a record pace. The National Adequate Wiring Bureau is putting forth the most extensive promotional campaign in its history. Its program will be featured at the National Association of Home Builders Show in February. A new consumer's campaign in preparation will be based on the theme "Wire Now for Today and Tomorrow". Advertising is being directed at builders and architects throughout the year. This is strong promotion. It is still more effective when local electrical groups provide vigorous support at the most important point of all, where working plans are drawn and wiring systems are installed.

Correction

In the article, "Motor Stripping" in the December issue an error appeared in the footnote at the bottom of page 60. The article was abstracted from a thesis prepared by Delmar William Karger for the University of *Pittsburgh* Graduate School. We sincerely regret the mistake in the name of the university, especially in view of the scope and importance of the work to the motor shop industry.

Hi Cycle Fluorescent

On 540 cycle alternating current power supply, a 40 watt fluorescent lamp operates at 120 percent overall efficiency. The ballast can be a small condenser. Resonant starting involves small, light components. These results of experiments by John H. Campbell and B. D. Bedford of Nela Park were reported at the I.E.S. technical conference in New Orleans and later at the International Lighting Exposition in Chicago last year. Further work on these lines, in our opinion, is bound to be rewarding for the whole electrical industry. Large, heavy inductive ballasts associated with each lamp in fluorescent lighting systems are necessary because of the characteristic of 60 cycle current. Impedance of inductive ballasts rise rapidly as frequency increases. Impedance of capacitive ballast decreases with frequency. Small, compact and highly efficient ballasts become easily practical in the high cycle range. Conversion from 60 to 540 cycles for power supply, however, involves apparatus which tends to dim the outlook.

Present equipment in small units runs about 70 percent efficiency, which more than offsets the gain in fixture efficiency. The market opportunity which high cycle fluorescent lighting offers, however, may stimulate the development of high efficiency conversion equipment in sizes appropriate to large scale applications.

Cool Heat

The grounding of DC6 planes last fall due to heating system defects ought to arouse more interest in electric heating, not only for planes, but for many space heating jobs where heat is needed but high temperatures are dangerous. In any fuel heating system, the heat must start in the form of combustion in the order of thousands of degrees. It must then be transmitted by some medium such as air or steam to the place where it is used. The transmitting medium usually operates at temperatures in the order of hundreds of degrees. The temperatures eventually required are usually ordinary room temperatures in the 70s. With ordinary electric panel heating no part of the heating system need exceed 100 degrees under the most severe weather conditions. Furthermore, electric heat can be made instantly responsive to precise control in ordinary practical applications.

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INADEQUATE WIRING, the industrial jinx, embezzles millions every year. It would take quarts of red ink to record the toll he takes in unproductive wages, lost production and spoilage.

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EXAMPLE

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ANACONDA WIRE & CABLE COMPANY

FUTURE CAPACITY

OVERCOMING the feeder bottleneck is usually the most expensive and difficult part of electrical modernization in existing buildings. Many lighting modernization or air conditioning jobs could be installed easily and economically if the present feeders or raceway facilities could take it. Usually they can't.

OUR LAST major building era was at its height just twenty years ago. Two watts per square foot was liberal design. Some courageous souls allowed for substantial future capacity in feeder or raceways against the usual grumbling about gold plating the electrical work. If some prophet among them had recommended future capacity based on actual 1948 loads he would have risked his engineering reputation.

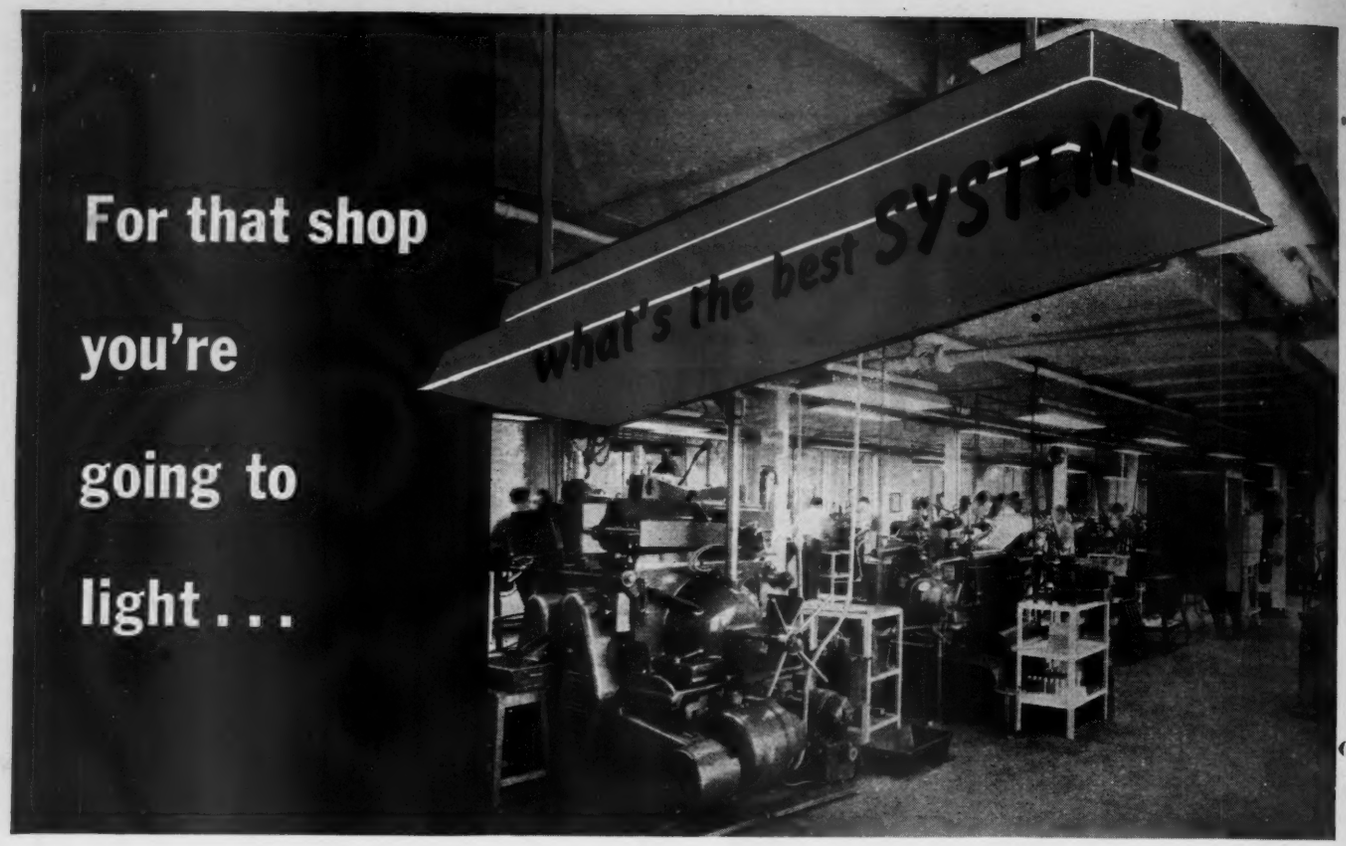
REQUIRED SYSTEM CAPACITY has approximately doubled each decade. This is a matter of history. Are we willing to extend the curve today into the years ahead? We must accept past electrical development as validly predicting the future course. We can reject such clear history only on the most compelling alternative evidence.

ELECTRICAL MEN who are responsible for the design of wiring installations in buildings now under construction have a far more serious professional responsibility for appraising future capacity needs than their counterparts of twenty years ago. There is more industry experience bearing on the rate of growth of electrical requirements. We are surrounded with clear examples of electrical obsolescence occurring in a small fraction of normally useful building life.

ELECTRICAL REQUIREMENTS evidently are going to double in the next ten years or so. The feeder capacity installed or provided for in current installations ought to be double the present required capacity just to serve the structure adequately over that short span. Additional facilities for the period beyond ought to be provided but seem hardly practical at this time. Further multiplications of system capacity requirements may have to be met by quite different kinds of distribution systems.

ONE HUNDRED PERCENT FUTURE CAPACITY must be a minimum design consideration in today's wiring systems. It sounds liberal but we must remember that it is not enough to insure electrical adequacy for more than a very brief period. It is, however, far more realistic than designing to immediate connected load or allowing for only small future load increases. There are few probabilities in our business life more certain than continuing growth in electrical utilization.

Wm. F. Stuart



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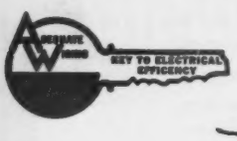

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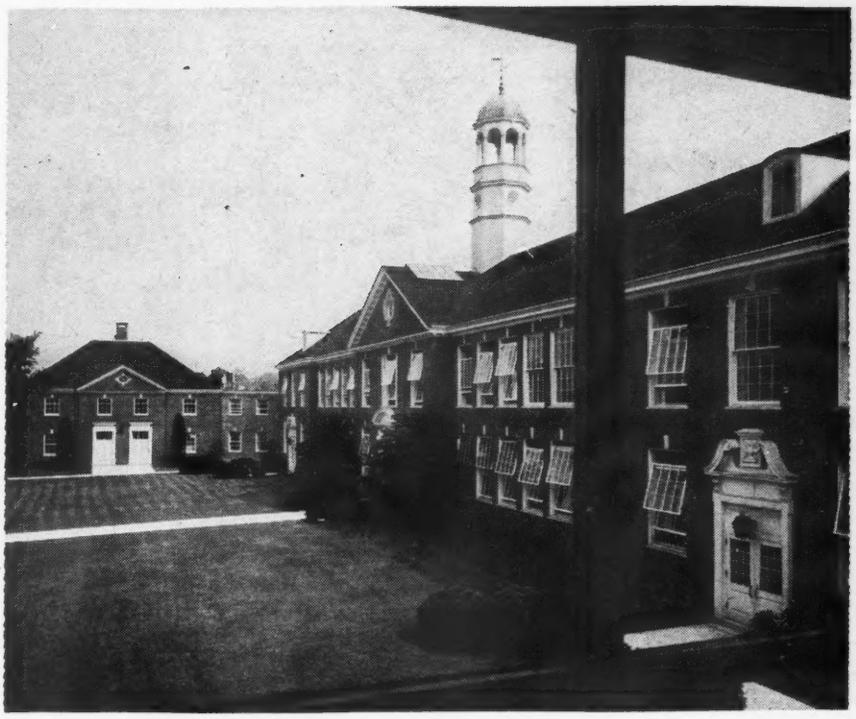


In an impressive American Colonial setting, research chemists and engineers develop new products in this modern 140-room laboratory center for the Celanese Corporation of America. Physical conversion and electrical expansion was engineered by Wigton-Abbott Corporation, with C. P. Dean as electrical contractor.

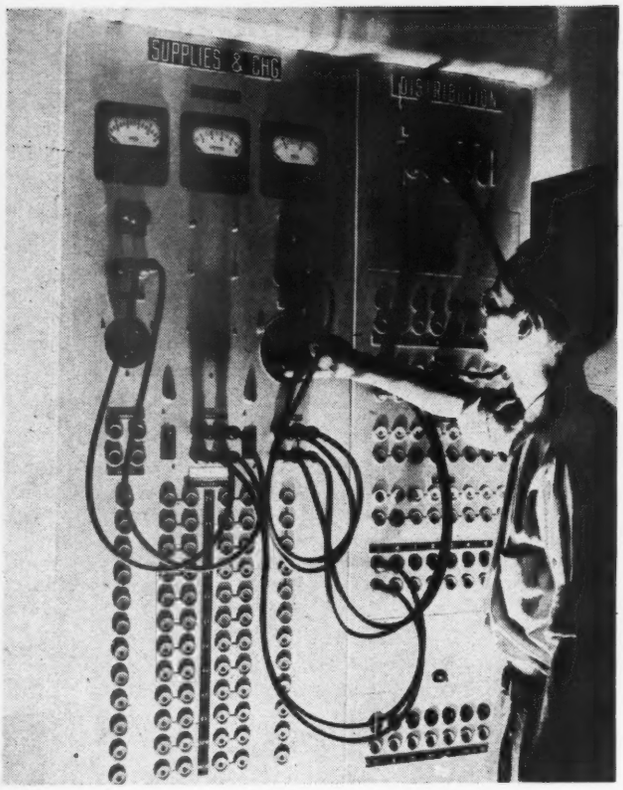
Wiring Revamped for Research

Transition of school buildings to modern laboratory development involved problems of electrical distribution and control, lighting, ventilation, safety and construction.

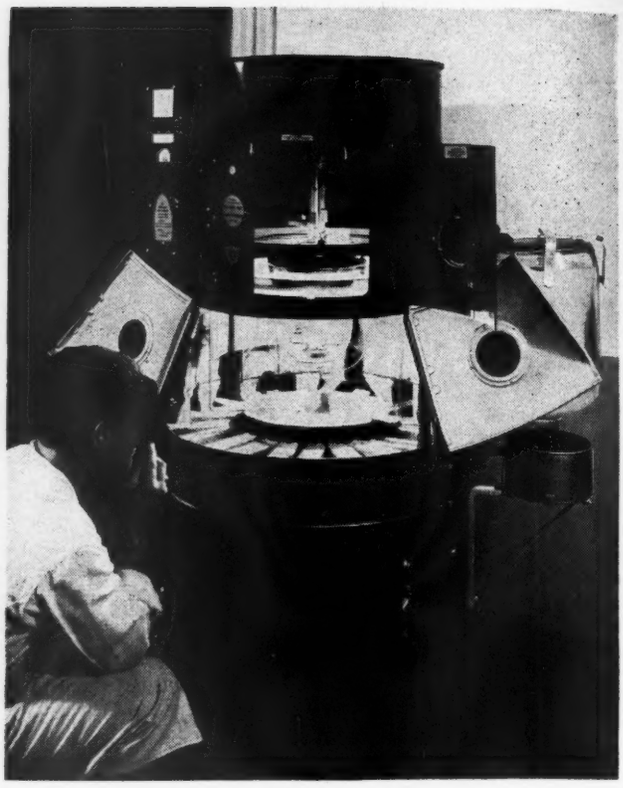
By Hugh P. Scott

SOMETHING different in laboratories is receiving considerable attention from research personnel throughout lab-packed northern New Jersey. The plant is that of the Celanese Corporation of America, with the objective of centralizing the specialized equipment and technical manpower required for the chemical and physical studies of cellulose, synthetic organics and dyestuffs. The uniqueness of the development, from an electrical viewpoint, is in the fact that the buildings were planned for purposes other than experimental and the transition for research work created problems of an expanded distribution system, transformation and control of power, lighting, ventilation, safety, layout and construction. Solutions to these problems were engineered and executed by the Wigton-Abbott Corporation of Plainfield, New Jersey, with the electrical phase of the work under the direction

Primary lighting in laboratory areas is furnished by 2-lamp louvred fluorescent fixtures. Bench receptacles supply 208/120 volt a-c for special equipment. Other utility services include water, brine, steam, air, vacuum and compressed air.



Special distribution panel delivers a-c at any desired voltage from zero to 135 volts and d-c from 2 to 40 volts in two-volt intervals.



Ultra-violet fadeometer, measuring resistance of colors to fading action of sun, is one of many special electrical machines in the laboratory.

of R. C. Hodges. The physical alteration and enlargement of the distribution system was by electrical contractor C. P. Dean, Inc., Summit, N. J.

Designed and initially utilized as a Junior High School, the development consists of a central two-story building, forming a block Tee, and two symmetrical flanking structures connected to the main unit by quarter-circular walkways. Classrooms originally occupied the central building, while the wings served as an auditorium and gymnasium. The buildings, of American Colonial architecture, are constructed of red brick and are situated on an impressively-landscaped tract of land on the outskirts of Summit, New Jersey.

In its new role as a 140-room research center, the central building now houses administrative offices, conference rooms, space for clerical workers, and modular laboratory units. The high-ceiling gymnasium has been converted into two tiers of additional laboratories while the auditorium is serving its intended purpose as a place for employee-management meetings, lectures, motion pictures, entertainment and other stage presentations.

As a school building, the connected load was 184 kw., primarily devoted to lighting with a small increment going to 15 installed motors ranging from fractional to 5 hp. in capacity. Utility service was 3 phase, 4 wire, 208/120 volts, entering the building through an underground entrance.

As a laboratory, the lighting load has been more than doubled. Special equipment, connected to 208/120 volt table receptacles, has an added gross connected load of approximately 1000 kw. In addition, power at 480 volts is required for compressors, blowers, pumps, preheaters, grinders, dust collectors, injection machines, mixers, washers and other specialized apparatus. But, while the connected load is relatively high, the demand factor is low, and a single 750 kva., 3 phase, 60 cycle, 2400/4160/480 volt, oil cooled outdoor primary transformer is sufficient for now-prevalent plant operations. Present utility service is 2400 volts with provisions for delivering current at 4160 or 13000 volts as plant expansion and the conjunctional increase in load necessitates. Two sets of three 500 MCM WP cables are airborne from this primary substation at the property line, across a macadam-paved parking area, to a 35-foot pole adjacent to the main building. AVL cables then run through sub-grade conduit to basement-located switch cubicles.

Passing from these cubicles through air circuit breakers, power is carried directly to five 480 volts, 3 phase, 3 wire power panels (one in the basement and four on the first floor) and five, dry type, 150 kva., 480/208/120 volt, 3 phase transformers (two in the basement and three in the overhead above the second floor). Strategically located panels throughout the plant control the lighting and power for either a single large laboratory or a group of smaller ones. All receptacles in laboratories are 3-wire; designed to receive only grounded polarized plugs. Lab receptacles are fed through 10-gauge wires in ¾-inch conduit so that, should single circuits prove inadequate for local requirements, one or two extra wires can be pulled through existing conduits to establish added capacity.

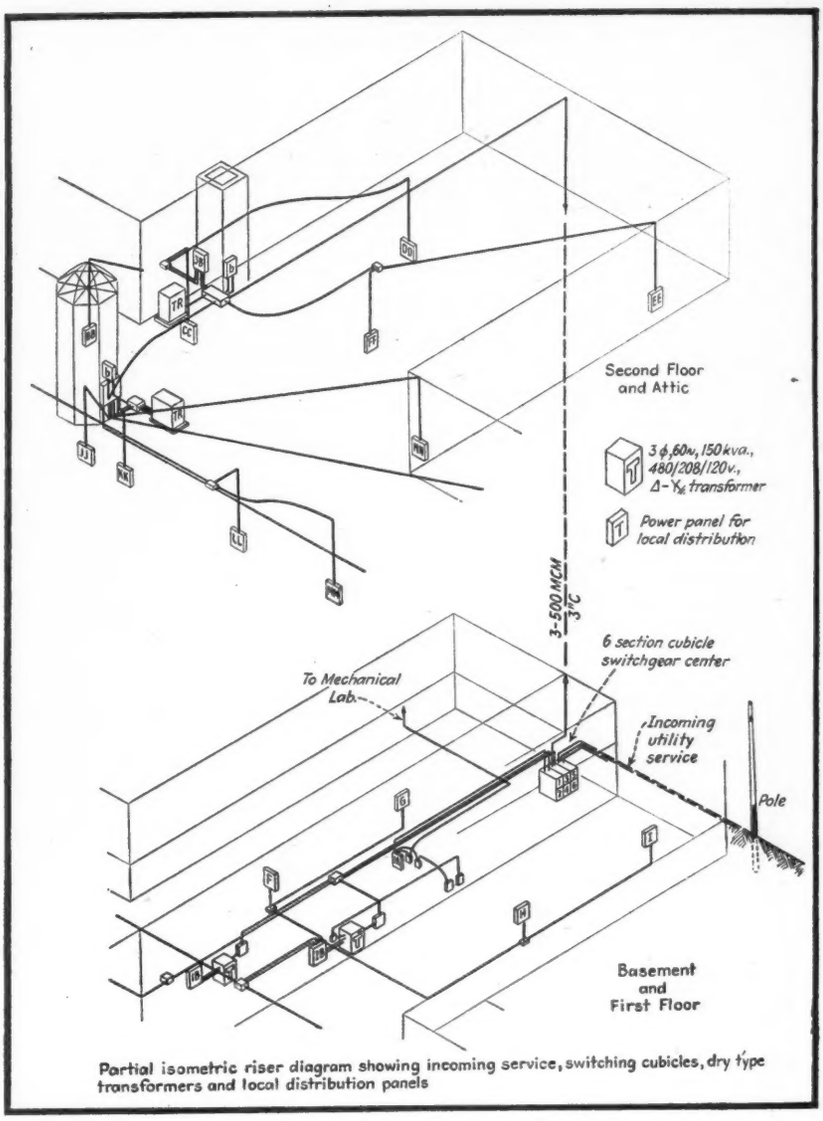
In routing new feeders, locating dry type transformers and laying cables between distribution panels and local load centers, the Colonial architectural design of the buildings was of considerable assistance, since the incline of the peaked roofs provided useful attic space above the second floor ceiling for locating equipment. Reinforced concrete pads, located directly over interior bearing walls, were constructed in these attic spaces to support sec-

ondary transformers. Feeders, in rigid conduit, were then run in direct lines by the shortest routes from 208/120 volt distribution boards to points directly above second-floor power and lighting panels. All wiring in attic space is type RH. Transformer shells, panel boards and safety switch enclosures are permanently grounded. The construction of the buildings also minimized lengths of feeders and the necessity for channeling floor slabs in locating first-floor panels. Although the basement extends beneath only part of the main building, a 4-foot crawl space exists under most of the total building area and it was possible to utilize this space to carry sub-floor runs to positions directly beneath the desired locations for first floor panels.

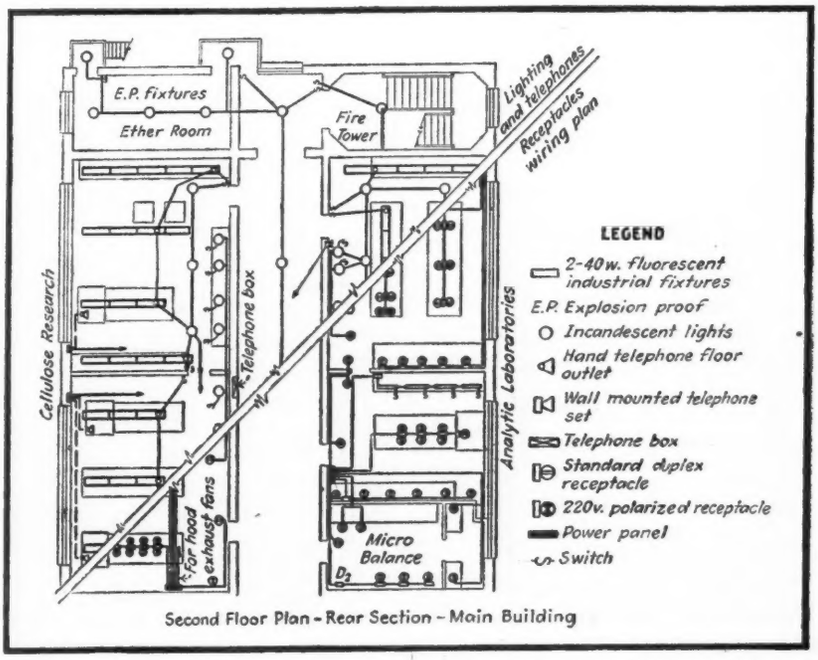
At the time of initially appraising the school buildings for laboratory possibilities, illumination levels were found to be well below present day standards although, augmented by natural light through the large windows, classroom illumination was considered ample by decade-old criterions. When measured as a separate entity, however, the artificial illumination ranged from a high of 15 footcandles in the shop and library, to a low of 2 footcandles in sections of the lobby and locker alcoves. All installed lamps were incandescent, consisting principally of 300-watt Silvrays in totally-indirect fixtures, and 150-watt PS lamps enclosed by diffusing globes.

In relighting the buildings, fluorescent fixtures were used as the primary source of illumination in laboratory areas. Fixtures are 2-lamp (daylight and 3500-degree white) 40-watt units mounted singly and in continuous runs, with lamps shielded by deep eggcrate louvres. Special laboratory areas, such as beneath ventilating hoods and in ether rooms, are equipped with both incandescent and fluorescent vapor-proof and explosion-proof lighting units. Over tables and desks where critical seeing is essential, recessed lensed units provide concentrated high-intensity incandescent light. The Silvray fixtures, removed from these areas, were reinstalled in administration offices, clerical areas and corridors to augment the Silvray units already installed there. With a greater number of fixtures in the same area, units are now spaced on approximate 7-foot centers in both directions at a height of 8.5 feet. Throughout the buildings, artificial intensities now range from 20 to 50 footcandles and, aided by natural light through the glass areas, nor-

(Continued on Page 162)


Second Floor and Attic
3 ϕ, 60w, 150 kva., 480/208/120v., Δ-Y transformer
Power panel for local distribution
3-500 MCM 3"C
6 section cubicle switchgear center
To Mechanical Lab.
Incoming utility service
Pole
Basement and First Floor

Partial isometric riser diagram showing incoming service, switching cubicles, dry type transformers and local distribution panels



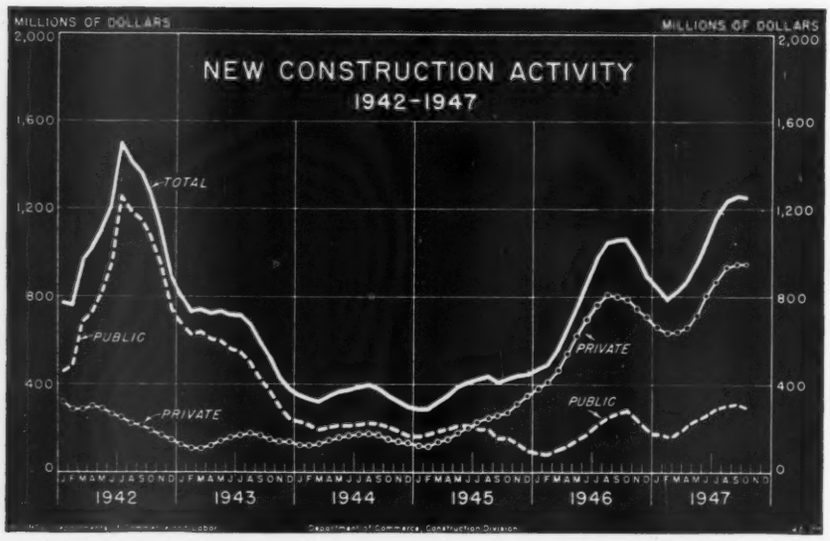
Second Floor Plan - Rear Section - Main Building

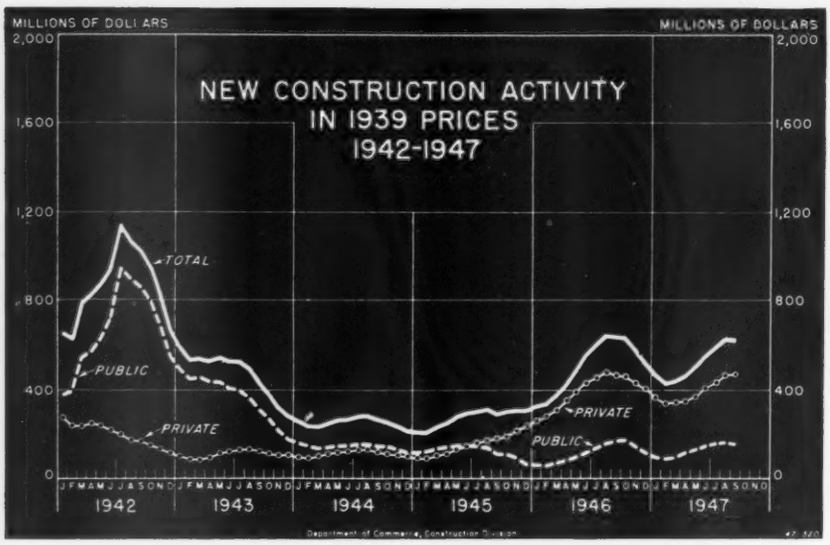
Wiring plan of second floor, main building, rear section, indicates locations of lighting fixtures and circuits, telephone outlets, receptacles and panels.

OUTLOOK for '48

New highs in electrical construction, new areas of market development for electrical contractors are due in '48. An editorial appraisal of industry trends and what they are likely to bring in the year ahead.

By W. T. Stuart





New construction activity in millions of dollars at prevailing prices and in 1929 prices shows volume still below wartime peak in 1942. Predictions are optimistic for 1948 in both dollar and physical volume.

IN dollars, 1948 is expected to be the biggest year in construction industry history. Predictions of the Department of Commerce and the Bureau of Labor Statistics are that they expect total new construction volume to go to $15,200,000,000. This is 20 percent over the 12½ billion dollar figure marked up in 1947.

Not all of this increase will be reflected in physical volume, however, since some additional increase, about 10 percent, in average costs from '47 to '48 are indicated. The forecast assumes there will be no recession in the next year. In any event a recession would have to appear relatively early in the year to appreciably affect construction plans.

Somewhat less optimistic is a prediction by Thomas S. Holden of F. W. Dodge Corp. He predicts an increase of only 7 percent with a probable slide back in the early months similar to that which hit in the second quarter of 1946.

Most predictions foresee a slowing down in industrial construction. This is the only category, however, which is expected to show less volume in 1948 than in 1947. John L. Haynes, chief of the Department of Commerce construction division sees a rise in private non-residential and commercial building that will more than offset the industrial decline.

The expected upswing will be mostly in private construction which accounts for over two-thirds of total aetivity. Large increases are expected, however,

GREATEST CONSTRUCTION YEAR AHEAD

	New Construction		Est. 12 mo. '47	Est. '47 Elec. Wk.	Projected '48 Elec. Wk.
	10 mo. '47	10 mo. '46	Millions of dollars		
Total New Construction	**10,275**	**7,998**	**12,785**	**1,163**	**1,405**
Total Private	**7,871**	**6,283**	**9,791**	**969**	**1,150**
Residential (excl. farm)	3,779	2,528	4,779	382	458
Non-Residential	2,602	2,746	3,168	425	496
Industrial	1,436	1,352	1,712	257	283
Warehouse, Office, Loft Building	216	246	256	28	34
Stores, Restaurants, Garages	476	702	616	82	115
Other	474	446	584	58	64
Farm	410	320	510	41	49
Public Utility	1,080	689	1,334	121	147
Railroad	258	198	320	19	23
Telephone and Telegraph	359	239	439	44	55
Other	463	252	575	58	69
Total Public	**2,404**	**1,715**	**2,994**	**194**	**255**
Residential	163	268	181	14	28
Non-Residential	402	269	488	59	82
Industrial	25	72	27	4	4
Educational	205	82	249	30	45
Hospital and Institutional	62	74	76	11	13
Other	110	41	136	14	20
Military and Naval	162	155	200	16	16
Highway	953	573	1,233	61	73
Sewer and Water	250	156	306	15	18
Misc. Public Service	100	74	116	6	8
Conservation	307	194	385	19	24
All Other	67	26	85	4	6

in the public works. A $310,000,000 expansion in highways and a $150,000,000 growth in hospital building will account for about half of the increase in the public category.

In electrical work the period ahead deserves a confidently optimistic outlook. In the accompanying construction tables the current statistics of the Department of Commerce are used as a basis for estimating the electric work total for 1947. Then, from many current industry predictions, the estimates are extended to the probable 1948 values. (The same methods used for a similar forecast in January 1947 proved out about 10 percent under the actual '47 total. An appropriate correction is included in the 1948 forecast.)

Remodel, alteration, changeover, and repair, together with the very large prospective relighting market are beyond the available construction statistics and is estimated to be about 20 percent of total electrical work. A conservative value of 250 million must, therefore, be added to the new construction total to cover this class of work, bringing the total market above $1.6 billion, a clear new all-time high in electrical construction and installation work.

Some restraint to this almost too optimistic forecast is indicated. The amount of electrical work as a percentage of the building dollar depends to a very significant extent on aggressive promotion and close cooperation throughout the electrical industry in developing the market. Competition for the building dollar in the presence of continuing pressure to keep total building costs down is going to be keen. Historically, when building budgets are trimmed, the electrical work is likely to be cut out of all proportion to its modest share.

In housing, now a tremendous percentage of total building, builders are still reluctant to install more than a minimum code job. When buyer preference can begin to operate this market will need vigorous development. Local adequate wiring activities will have to have far stronger cooperation from all branches of the industry.

Will power shortage tend to weaken the load building activities of the utilities? Always a strong promotional influence for the industry, utility light and power sales efforts will have a significant effect on the 1948 market for electrical work.

Continuing shortage of steel may tend to brake the rate of expansion in construction activity. A shortage of skilled labor, of experienced supervisory personnel or of needed job tools can limit the job handling effectiveness of established electrical construction organizations. These possibilities are enough to counsel caution. The coming year will have its full quota of problems to be overcome.

Our appraisal assumes a moderate improvement in industry perspectives, a reasonable amount of industry cooperation and some aggressive sales effort. If the national economy remains fairly stable in the overall pattern, electrical construction will probably ride through minor bumps. Electrical jobs are usually carried out over a relatively long period from plan to final payment giving the industry a flywheel momentum that ignores short term fluctuations in general business progress.

Television Master Antenna Systems

Directional antennas, pretuned amplifiers and coaxial distribution systems are major factors in promoting a new multi-million dollar industry.

By Morris Salit, *Brown Electric Company, New York, N. Y.*

MASTER antenna systems for television and FM, one of the greatest technical advances in commercial television to date, are being installed successfully by electrical contractors. The installation of these systems offers a complete practical solution to a problem which has been vexing television manufacturers, engineers, and realty owners for months.

Until recently, apartment house owners in New York City, acting through their State Real Estate Board, would not permit the erection of individual aerials. Similar action was taken by landlords in other cities. The objection to the disfiguring and hazardous maze of aerials is understandable. Also serious was the interaction between a number of antennas operating independently in close proximity, resulting in impaired reception on the individual receivers. For these reasons, sales of receivers to tenants in apartment houses were seriously affected.

This stumbling block is already being removed by the practical installation of master antennas.

Recent surveys estimate a potential market of 10 million television receivers in the next five to six years. The overwhelming majority of these potential users are obviously residing in urban areas in and around cities like New York, Philadelphia, Washington, Boston, Chicago, Detroit, St. Louis, San Francisco and Los Angeles. The majority of these cities already have television stations in operation. The others are about to commence operations. It is probably no exaggeration to assume that three or four million potential users of television receivers are tenants in apartment houses in the above cities. The ability to give them satisfactory reception is a fundamental essential for the success of television in general, and for the early profitable operation of manufacturers of television receivers and tele-broadcasters. Thus, the master antenna system makes a major technical contribution to television.

Installations of Intra-Video Television and FM Master Antenna Systems have already been made in multiple dwellings under difficult reception conditions. The equipment has been demonstrated to satisfy the exacting requirements of the television industry as well as non-technical laymen, realty firms, contractors, builders and architects who have attended demonstrations. It has received official endorsement from the Television Broadcasters Association, in which are represented all major television manufacturing and broadcasting interests.

Replacing individual antenna installations, unacceptable to realty interests, master antennas permit all television receivers in an apartment building to operate from a single antenna array. While tenants are proportionately charged for installation of television outlets, they save money in comparison to charges for the installation of individual external antennas.

A standard television installation costs between $50 and $75 per apartment when the cable is less than 75 feet in length. In most apartment buildings, however, 75 feet is only the distance between antenna and roof parapet. Therefore, charges for running cable to a tenant's apartment may be $100 above this base figure.

When a single antenna is installed, the tenant receives a compromise installation. The antenna has to be adjusted for all stations which are transmitting. Therefore, customers must accept poor-signals on some stations and ghosts on others. When a customer connects to a master antenna outlet, he has the benefit of an antenna tuned and adjusted for a specific station and an amplification system which strengthens weak signals. This gives the best possible reception for a particular location, seldom the fact with individual antennas.

The system, as installed by electrical contractors, permits the following:

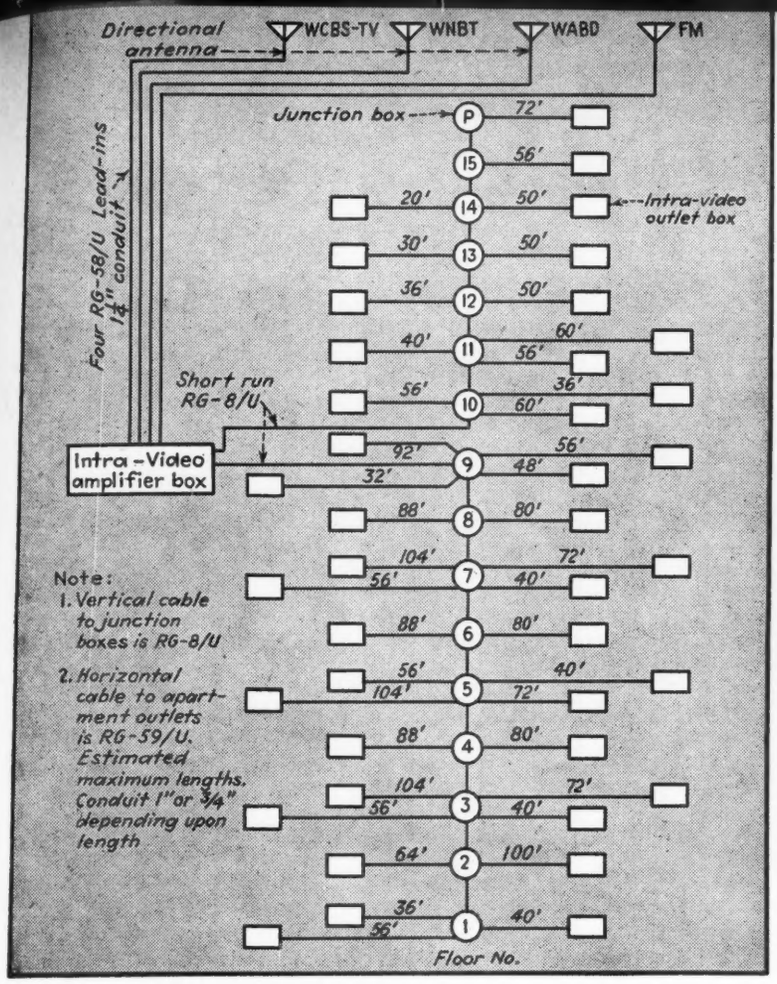
1. Television sets can receive any existing transmitter stations at any time, regardless of what other receivers are receiving. There is no interaction among receivers.

2. There is an abundance of signal energy from all stations. This satisfies the poor sensitivity of cheap receivers, and also guarantees satisfactory reception to a large number of receivers, such as in an apartment house.

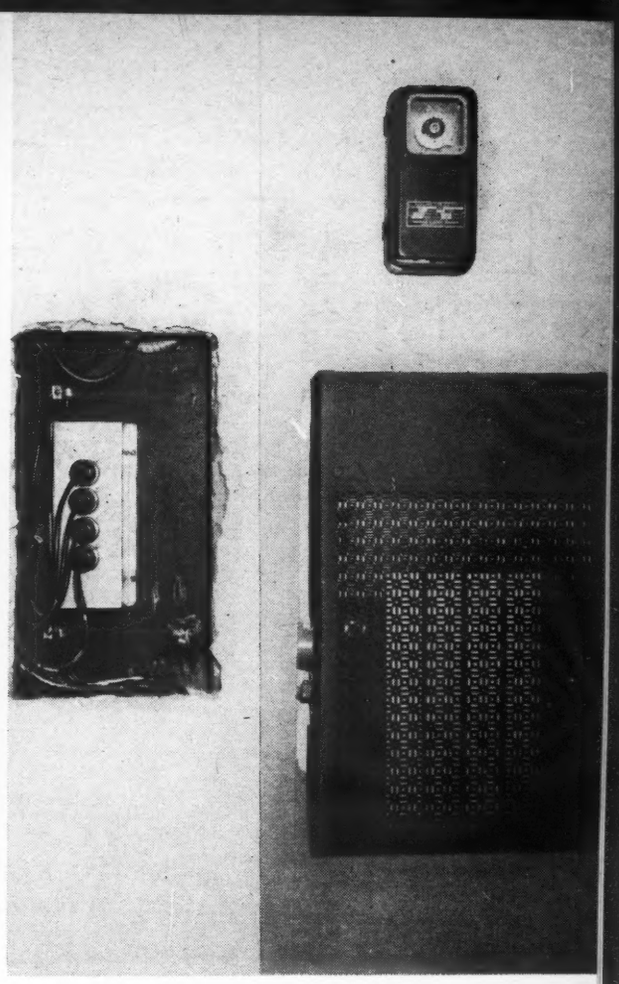
3. The system amplifies signals without distortion. Carrier frequencies remain unchanged.

4. The system permits use of any commercial television receiver without altering either the system or the receiver.

5. No tuning or other adjustments are required after installation. Except for occasional servicing, the system operates without attention.



Distribution from amplifier cabinet to apartment outlets can be through series of centrally-located junction boxes and branch runs, as above, or through multiple risers serving separate vertical areas.



Low-loss coaxial cables run from antennas to booster amplifier. Time switch activates amplifier whenever broadcasts are on the air.

The system comprises three main parts; directional antennas, a pretuned amplifier and the distribution network.

1. The directional antennas are vital requirements, for a master antenna must furnish a clear picture, as completely free from ghosts as possible. With the exception of noise, all other requirements are secondary.

To properly orient the antenna requires the work of two men, with a good television receiver, capable of at least 350 line definition. The antenna should be carefully assembled according to printed instructions, and wired to an RG-58/U coaxial cable, with enough slack to permit shifting the antenna over the entire roof area. The test receiver should be located as close as possible to the roof to allow its operator to communicate directly with the man orienting the antenna. If this is not convenient, then it becomes essential to provide telephone communication between the location of the antenna and receiver.

Tests begin with the antenna in the location most convenient for mounting, pointed roughly in the direction of the transmitter. The test receiver is then tuned to the transmitter's channel, and the picture carefully scrutinized for ghost images. The transmitted image should preferably be a standard test pattern, since this shows undesired ghost images most clearly. The first trial orientation of the antenna generally is unsatisfactory. If a perfect picture is not received after slowly rotating the antenna a full 360 degrees, the antenna must be moved to another spot and the process repeated. Considering installation possibilities, it is preferable to first try locations around the parapet or other convenient fastening place. In difficult cases, the entire roof may be covered without finding a completely ghost-free signal. In such situations, a map drawn of the roof and then crisscrossed like a gridiron will be helpful. Results in each position should be recorded. In the final analysis, it may be necessary to compromise on a position where ghosts are least apparent.

When the antenna for one channel has been definitely established, the procedure is repeated for each of the other channels to be received. Care must be taken to avoid interaction between antennas. Make sure that no antenna impairs the signal of another.

In mounting antennas, precautions should be taken to secure and protect them against winds and weather. In this connection, building codes must be complied with.

2. Pretuned amplifier.

Signals from each antenna are fed via cables to a booster amplifier, resembling a moderate-sized surface type panel box and located near the roof. These cables, as well as those of the distribution network, are flexible low-loss coaxial cables, fully screened against all interference, and protected by an extra heavy plastic jacket. Cables are about ¼ in. in diameter. The booster amplifier is fed from a 120-volt a-c 60-cycle power line and automatically switched on and off by an electric time switch. It will remain "ON" continuously as soon as television stations operate around the clock. The output of the amplifier may be circuited to Intra-Video outlets by either of two types of circuits, a central riser or dual circuits.

3. Distribution network.

Before outlets can be installed, the layout of the system must be approved by inspectors from Intra-Video to in-

[Continued on page 117]

Conduit

By A. A. Schuhler

TABLE 1—GROUPED SINGLE CONDUCTORS

Size AWG	Insulation R-39, R, RH, RW* Over. Diam.	Insulation R-39, R, RH, RW* Approx. Area Sq. In.	Insulation TF, T, TW, RU* Over. Diam.	Insulation TF, T, TW, RU* Approx. Area Sq. In.	Insulation RF-64** Over. Diam.	Insulation RF-64** Approx. Area Sq. In.	Maximum Number Conductors in Conduit: ½ in. Int. Area .30 Sq. In.	¾ in. Int. Area .53 Sq. In.	1 in. Int. Area .86 Sq. In.	1¼ in. Int. Area 1.50 Sq. In.	1½ in. Int. Area 2.04 Sq. In.	2 in. Int. Area 3.36 Sq. In.	2½ in. Int. Area 4.79 Sq. In.	3 in. Int. Area 7.38 Sq. In.
18	.146	.0167	.106	.0088			7	12	20	35	49	80	115	176
18					.100	.0079	14	24	42	73	100	165	236	364
16	.158	.0196	.118	.0109			6	10	17	30	41	68	97	150
16					.113	.0100	12	19	33	58	79	131	186	287
14	.171	.0230	.131	.0135			4	6	10	18	25	40	59	90
12	.188	.0278	.148	.0172			3	5	8	15	21	35	50	77
10	.242	.0460	.168	.0224			2	4	7	13	17	29	41	64
8	.311	.0760	.228	.0408			1	3	4	7	10	17	25	38
6	.397	.1238	.323	.0819			1	1	3	4	6	9	15	23

Combination of Conductors

*

1—No. 14 Equal to
2— " " " "
3— " " " "
1— " 12 " "
2— " " " "
3— " " " "

1—No. 18 or 1 No. 16
2— " " 2 " "
4— " " 3 " "
1— " " 1 " "
3— " " 3 " "
4— " " 4 " "

**

3—No. 18 or 2 No. 16
5— " " 4 " "
8— " " 7 " "
3— " " 3 " "
7— " " 5 " "
10— " " 8 " "

Note: * In accordance with NEC.
** Approved by special permission.

{Above sizes apply to straight runs or with nominal offsets equivalent to not more than two quarter-bends

CONDUITS used in low-tension signaling and communication systems must be selected on the same basis as those installed for lighting work. The 1947 National Electrical Code is quite specific about this, and assures adequate space which should minimize difficulties in the proper operation and maintenance of the systems.

All conduits must be of sufficient size to enable the wires or cables to be pulled in or to be withdrawn without using undue force. In this way the wedging effect is practically eliminated, and injury to the insulation and breakage of wires is very remote.

The proportion of the cross-sectional area of the interior of the conduit, in relation to the conductors to be drawn into it, has been established by the Code, to some degree, by means of tables. This refers particularly to individual conductors and cables of the same gauge size. However, where combinations of conductors occur, that is, where different sizes of wire are run in the same conduit, the percentage formula is given. The Code Table II recommends the maximum percentage based on the number of conductors.

The Code tables in general include new concealed and surface type installations. Provision is made for rewiring of existing concealed installations whereby an increased number, or sizes of conductors may be used.

In signaling and communication work, most of the conductors range from No. 16 gauge wire, down to and including No. 22 gauge wire. In signaling systems the Code provides for a minimum of No. 18 gauge wire having 1/32 inch rubber insulation or its equivalent in thermoplastic insulation. In practice, however, No. 16 gauge wire should be the smallest size used with 1/32 inch rubber insulation or its equivalent. This is to assure additional tensile strength where a large number of conductors are pulled into conduit. Ordinary cotton-covered paraffined insulated conductors such as bell wire and office wire are not permitted for use in conduit systems.

In intercommunicating telephone work the cables have the usual silk and cotton insulation over the bare copper wires, with either a braided, plastic or leaded outer covering. The conductors in these cables provide No. 22 gauge wire for the section or point wires, and additional No. 18 gauge

TABLE 2A—SIGNAL SYSTEM CABLES

Rubber Covered

No. Cond.	No. 18—1/64" R* Over. Diam.	No. 18—1/64" R* Approx. Area Sq. In.	No. 18—1/64" R* Conduit Size	No. 18—1/32" R Over. Diam.	No. 18—1/32" R Approx. Area Sq. In.	No. 18—1/32" R Conduit Size	No. 16—1/64" R* Over. Diam.	No. 16—1/64" R* Approx. Area Sq. In.	No. 16—1/64" R* Conduit Size	No. 16—1/32" R Over. Diam.	No. 16—1/32" R Approx. Area Sq. In.	No. 16—1/32" R Conduit Size
10	0.49	0.188	¾"	0.61	0.292	1"	0.53	0.219	1"	0.65	0.330	1"
20	0.63	0.314	1"	0.80	0.503	1¼"	0.69	0.377	1¼"	0.85	0.565	1¼"
30	0.74	0.322	1¼"	0.94	0.691	1½"	0.81	0.518	1¼"	1.01	0.802	1½"
40	0.83	0.541	1¼"	1.06	0.880	2"	0.92	0.668	1½"	1.14	1.021	2"
50	0.93	0.675	1½"	1.18	1.094	2"	1.02	0.817	1½"	1.27	1.254	2"
60	1.00	0.785	1½"	1.28	1.288	2"	1.10	0.950	2"	1.38	1.492	2½"
70	1.10	0.950	2"	1.41	1.563	2½"	1.21	1.147	2"	1.53	1.838	2½"
80	1.15	1.037	2"	1.48	1.720	2½"	1.27	1.254	2"	1.60	2.011	3"
90	1.21	1.147	2"	1.54	1.861	2½"	1.32	1.367	2½"	1.67	2.191	3"
100	1.28	1.288	2"	1.66	2.168	3"	1.41	1.563	2½"	1.79	2.513	3"
125	1.40	1.539	2½"	1.82	2.592	3"	1.56	1.909	2½"	1.96	2.974	3½"
150	1.54	1.861	2½"	1.99	3.110	3½"	1.70	2.260	3"	2.15	3.628	3½"
175	1.66	2.168	3"	2.14	3.596	3½"	1.83	2.631	3"	2.31	4.163	4"
200	1.77	2.458	3"	2.28	4.084	4"	1.95	2.984	3½"	2.47	4.791	4"

* Approved by special permission only.

Sizes for Signal Systems

Essential data to determine raceway requirements for signal and communication systems using modern insulations under the new code rules.

wires for the current supply or feeder wires. The duplex and triplex twisted wires used in telephone work may be secured in rubber covered or plastic insulation and in No. 19 or No. 22 gauge wire.

Conduits should be run in the same manner as for lighting installations. The bends should be reduced to a minimum, and junction, pull and terminal boxes used generously. The use of terminal strips at these points eliminates splices and permits of ease in connecting, disconnecting and testing wires and locating troubles in circuits.

The accompanying tables cover the types of conductors and cables used in low-tension signaling and communication systems. They are based upon data shown in the tables of the Code and are extended to include quantities of conductors most frequently used in this class of work.

Table 1 is composed of data on single conductors grouped together for use in systems where the wires are all of the same gauge. A section of this table also includes combination of conductors used with the smaller wires and in the sizes most frequently installed. These larger size conductors are generally used as feeders, while the smaller are used as section or point wires. Details as to various standard insulations, overall diameter, approximate area in square inches and the maximum number of specific size conductors which will fit into standard

TABLE 3—PAGING SYSTEM CABLES

No. Cond.	No. 14—$\frac{1}{64}$" R			No. 12—$\frac{1}{64}$" R			No. 14—$\frac{1}{64}$" RL				No. 12—$\frac{1}{64}$" RL			
	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Cond. Size
12	0.84	0.554	1½"	0.94"	0.680	1½"	0.97"	0.738	$\frac{1}{64}$"	1½"	1.05	0.864	$\frac{1}{64}$"	2"
20	1.10	0.950	2"	1.19"	1.112	2"	1.20"	1.130	$\frac{1}{64}$"	2"	1.32	1.367	$\frac{1}{64}$"	2½"
24	1.21	1.147	2"	1.31"	1.348	2"	1.35"	1.420	$\frac{1}{64}$"	2½"	1.45	1.649	$\frac{1}{64}$"	2½"

TABLE 2B—SIGNAL SYSTEM CABLES

Rubber and Lead

No. 18—1/64" RL*				No. 18—$\frac{1}{32}$" RL				No. 16—1/64" RL*				No. 16—$\frac{1}{32}$" RL			
Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size
0.56	0.243	4/64"	1"	0.69	0.377	4/64"	1¼"	0.61	0.292	4/64"	1"	0.73	0.416	4/64"	1¼"
0.70	0.385	4/64"	1¼"	0.90	0.636	5/64"	1½"	0.76	0.454	4/64"	1¼"	0.96	0.723	5/64"	1½"
0.82	0.528	4/64"	1¼"	1.05	0.864	5/64"	2"	0.92	0.665	5/64"	1½"	1.12	0.985	5/64"	2"
0.94	0.680	5/64"	1½"	1.17	1.076	5/64"	2"	1.02	0.817	5/64"	2"	1.28	1.288	6/64"	2"
1.03	0.833	5/64"	2"	1.32	1.367	6/64"	2½"	1.12	0.985	5/64"	2"	1.41	1.563	6/64"	2½"
1.10	0.950	5/64"	2"	1.41	1.563	6/64"	2½"	1.20	1.130	5/64"	2"	1.51	1.791	6/64"	2½"
1.21	1.147	5/64"	2"	1.55	1.885	6/64"	2½"	1.35	1.413	6/64"	2½"	1.66	2.168	6/64"	3"
1.29	1.304	6/64"	2"	1.61	2.035	6/64"	3"	1.40	1.539	6/64"	2½"	1.76	2.435	7/64"	3"
1.33	1.390	6/64"	2½"	1.68	2.199	6/64"	3"	1.46	1.673	6/64"	2½"	1.83	2.631	7/64"	3"
1.42	1.571	6/64"	2½"	1.82	2.592	7/64"	3"	1.55	1.885	6/64"	2½"	1.95	2.985	7/64"	3½"
1.54	1.885	6/64"	2½"	1.98	3.063	7/64"	3½"	1.69	2.246	6/64"	3"	2.12	3.526	7/64"	3½"
1.68	2.199	6/64"	3"	2.15	3.628	7/64"	3½"	1.86	2.717	7/64"	3"	2.34	4.304	8/64"	4"
1.82	2.592	7/64"	3"	2.33	4.265	8/64"	4"	1.99	3.110	7/64"	3½"	2.50	4.909	8/64"	4"
1.93	2.906	7/64"	3"	2.47	4.791	8/64"	4"	2.11	3.495	7/64"	3½"	2.66	5.553	8/64"	4½"

* Approved by special permission only.

TABLE 4—PAIR TELEPHONE CABLE

No. Pairs	Pairs No. 22 & 2 Pairs No. 18						Pairs No. 22 Only					
	Braided			Leaded			Braided			Leaded		
	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size
6	0.36	0.102	½"	0.45	0.159	¾"	0.29	0.066	½"	0.33	0.086	½"
12	0.41	0.132	¾"	0.50	0.196	¾"	0.38	0.113	½"	0.42	0.139	¾"
16	0.50	0.196	¾"	0.59	0.273	1"	0.42	0.139	¾"	0.47	0.174	¾"
22	0.57	0.255	1"	0.66	0.342	1"	0.49	0.188	¾"	0.53	0.220	1"
32	0.62	0.302	1"	0.71	0.396	1¼"	0.57	0.253	1"	0.61	0.292	1"
41	0.74	0.430	1¼"	0.85	0.567	1¼"	0.61	0.292	1"	0.66	0.342	1"
51	0.88	0.608	1½"	0.97	0.739	1½"	0.70	0.385	1¼"	0.76	0.454	1¼"
65	0.92	0.665	1½"	1.01	0.802	2"	0.76	0.454	1¼"	0.83	0.541	1¼"
75	0.95	0.709	1½"	1.03	0.833	2"	0.82	0.528	1¼"	0.89	0.622	1½"
85	0.98	0.754	1½"	1.07	0.899	2"	0.86	0.581	1¼"	0.93	0.679	1½"
100	1.08	0.916	2"	1.16	1.057	2"	0.94	0.694	1½"	1.01	0.802	1½"
125	1.18	1.094	2"	1.26	1.247	2"	1.01	0.802	1½"	1.08	0.916	2"
150	1.27	1.254	2"	1.34	1.410	2½"	1.12	0.985	2"	1.18	1.094	2"
175	1.37	1.474	2½"	1.44	1.624	2½"	1.18	1.094	2"	1.25	1.227	2"
200	1.45	1.649	2½"	1.57	1.938	3"	1.27	1.254	2"	1.34	1.410	2½"

size conduits are shown. The section on combination of conductors gives the equivalent values of the larger conductors No. 14 or No. 12 gauge to the smaller conductors No. 18 and No. 16 gauge. Note the column on 1/64 inch insulation which is only approved by special permission.

Table 2 is composed of data on signal system cables. This is based on standard sizes which are used in lieu of single conductors. Cables are particularly useful on long runs, saves labor and gives the conductors extra protection. Lead covered cables are included for use in damp and wet locations. Other details of the table are similar to those described for Table 1.

Table 3 includes cable frequently used with silent or lamp type paging systems. They may also be used in other annunciator and control systems, particularly where long runs are involved.

Table 4 covers data on pair type telephone cable. This includes two different types of cables, that is, one which is composed of a quantity of pairs No. 22 gauge wires only, and another which in addition to these pairs also is composed of two pairs No. 18 gauge wire. The first type is generally used in telephone switchboard installations. The second type is used in full metallic selective-ringing selective-talking intercommunicating telephone systems, and in telephone switchboard systems. When used in the latter, the No. 18 gauge pairs may be twisted together at the extreme ends and used as the common wire in order to provide greater conductivity. A separate and larger single wire may be pulled into the conduit as a common wire with the cable, however, this method is not always considered practical.

Table 5 covers data on single conductor telephone cable. This cable consists of a number of single conductors No. 22 gauge wire which are used for section or point wires, while the two pairs of No. 18 gauge wires are used for the supply of current to the system. The general use would be in systems of the common return type selective-ringing selective-talking, selective-ringing common-talking and master common-talking.

Table 6 is composed of data on duplex and triplex twisted rubber insulated conductors. These wires are used exclusively in telephone work, particularly for running wires from the instruments to a terminal cabinet, where they in turn are interconnected to the major cable system. Thermoplastic insulated wires of the twisted variety are also obtainable.

It is important to appraise raceway capacity for signal systems in the same way as power circuits for probable future requirements. If the building layout is such as to allow alterations from the original plan there is obvious need for a flexible and accessible raceway system to allow changes in the signal and intercommunication systems. Such extra raceway capacity can be provided in the original installation very economically. In finished buildings alterations inevitably involve expensive cutting and patching. Further, a little extra area for additional terminal strips in interconnecting cabinets involves almost negligible cost in the original installation yet greatly simplifies alterations and maintenance.

TABLE 5—SINGLE TELEPHONE CABLE

No. Cond.	Single No. 22 & 4 Single No. 18					
	Braided			Leaded		
	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size
6	0.26	0.053	½"	0.30	0.071	½"
11	0.28	0.061	½"	0.33	0.086	½"
16	0.31	0.075	½"	0.36	0.102	½"
26	0.36	0.102	½"	0.40	0.126	¾"
35	0.40	0.126	¾"	0.45	0.159	¾"
45	0.44	0.152	¾"	0.48	0.181	¾"
55	0.46	0.165	¾"	0.51	0.204	¾"
65	0.51	0.204	¾"	0.55	0.236	1"
75	0.53	0.219	1"	0.59	0.255	1"
85	0.55	0.236	1"	0.60	0.283	1"
100	0.60	0.283	1"	0.64	0.322	1"

TABLE 6—DUPLEX & TRIPLEX

Size AWG	Insulation Rubber Braid		Maximum Conductors in Conduit					
	Over. Diam.	Approx. Area Sq. In.	½ in. Int. Area .30 Sq. In.	¾ in. Int. Area .53 Sq. In.	1 in. Int. Area .86 Sq. In.	1¼ in. Int. Area 1.50 Sq. In.	1½ in. Int. Area 2.04 Sq. In.	2 in. Int. Area 3.36 Sq. In
22*	.20	.031	6	12	20	36	50	84
22†	.22	.038	9	15	24	45	60	102
19*	.24	.045	4	8	14	24	34	68
19†	.26	.053	6	9	18	33	45	75

Note: * 2 Wire twisted.
† 3 Wire twisted.

Use of vertical drawing boards eliminates shadows from T squares and triangles and permits use of direct lighting without annoying specular reflections

DRAFTING ROOM LIGHTING TECHNIQUES

An analysis of modern lighting techniques used to provide adequate and comfortable illumination in the drafting room.

By Berlon C. Cooper

Recessed 2/40-watt continuous-row louvered fluorescent troffers installed on three-foot centers provide a uniform intensity of more than 90 footcandles in the drafting room of The Austin Company, Cleveland.

THE big job ahead in the postwar American economy is construction. New factories are needed for greater production. New power houses are needed to furnish more power. New airports, railway facilities, bus and freight terminals are needed for greater transportation. New stores are needed to sell more consumer products. New office buildings are needed to carry on the commerce of the nation. And, perhaps greatest of all, more than a million new homes are needed each year for the next 15 to 20 years to adequately house the American people who work in these factories, stores, offices and homes.

A key figure in this job ahead is the draftsman. Every construction job needs a plan. It is the draftsman who makes this plan. It is his job to translate into detail drawings the dreams and visions of the planners and the engineers. Making these drawings places a serious demand on the draftsman's eyes. It involves accurate discrimination of fine detail, such as seeing fine pencil lines on tracing paper or on tracing cloth, and the checking of details on poor blueprint reproductions. This difficult seeing task is continuous during normal working hours, and the draftsman is often called on to do overtime work. It is highly important to the health and well being of the draftsman that he be provided with the best lighting which present knowl-

edge of the art affords, so that he may do this job quickly, efficiently, economically and comfortably, and with a minimum of eye fatigue.

Many lighting techniques have been used to light drafting rooms in the past. In general, an effort has been made to provide shadowless illumination with a minimum of direct or reflected glare. As a result, indirect or semi-indirect lighting has been favored. However, in an effort to arrive at the best solution possible to this problem, which is one of the most difficult in the field of illumination, engineers have used a wide variety of techniques (Table I), in providing artificial illumination for many of the drafting rooms now in use. Engineers have demonstrated unusual ingenuity in their use of the many lighting components and types of luminaires available. They have shown a particularly keen understanding of, and agreement on, the problem. This is demonstrated by the similarity of the lighting results achieved, even when the techniques used have varied greatly.

The seeing task in the drafting room may be described as *difficult,* involving as it does the discrimination of fine detail, under poor contrast, and over relatively long periods of time. The lighting intensity should therefore be as high as is economically practical. The Illuminating Engineering Society recommendation is for a minimum of 50 footcandles maintained in service. Installations involving 100 footcandles and above have been made, and are considered desirable if undue brightness contrasts or other objectionable features are not introduced in the final lighting result.

TABLE I

INDIRECT
- a. Luminaires suspended from flat ceiling
- b. Luminaires installed in coffers or between beams
- c. Luminaires suspended under Paralume ceiling

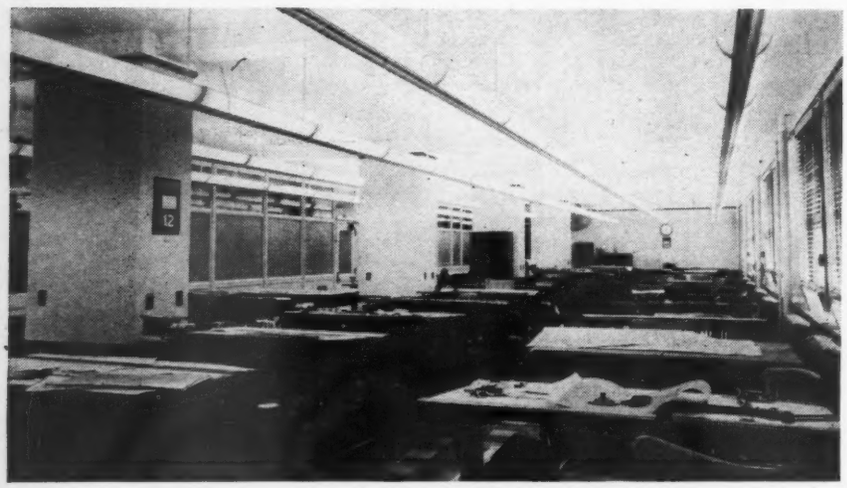
LUMINOUS INDIRECT OR SEMI-INDIRECT
- a. Suspended luminous luminaires

GENERAL DIFFUSE OR DIRECT-INDIRECT
- a. Suspended luminaires, open or translucent diffusing glass or plastic, or metal or plastic louvers, and with diffusing sides of glass or plastic.

INDIRECT PLUS DIRECT
- a. Suspended indirect luminaires supplemented with ceiling mounted direct luminaires.

DIRECT LIGHTING—GENERAL
- a. Luminous ceiling consisting of plastic, metal or wood louvers to shield light sources above.
- b. Luminous ceiling consisting of glass or plastic panels illuminated from above.
- c. Recessed troffers, equipped with louvers, glass or plastic diffusers, or prismatic glass lenses.
- d. Individual unit or continuous-row luminaires either suspended or surface mounted on ceiling.

DIRECT LIGHTING—LOCALIZED
- a. Large area low brightness luminaires installed over drafting tables.
- b. Industrial reflectors installed over drawing boards.

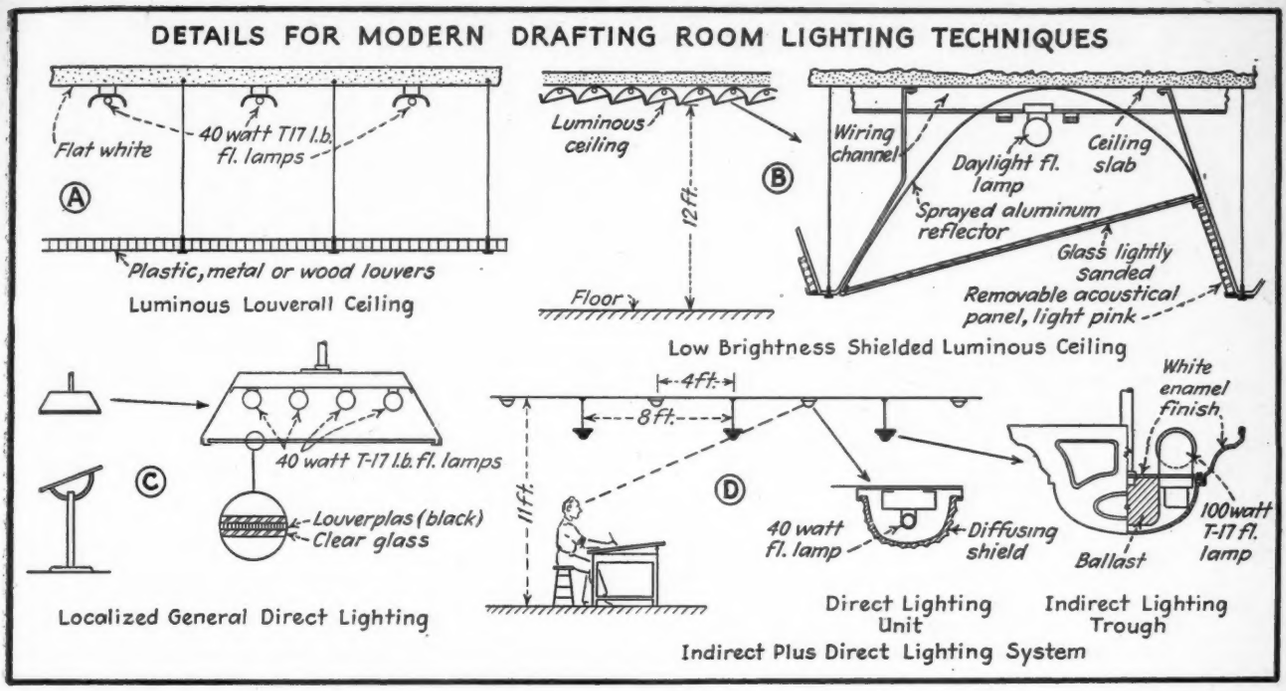


Continuous-row luminous indirect fluorescent luminaires using two 100-watt lamps per five linear feet of trough, provide over 75 footcandles in service in this installation. Rows are spaced 5 ft. 6 in. on centers.

Localized direct lighting from two 2/40-watt industrial type fluorescent reflector units, arranged in T mounting over each board, is used by J. E. Sirrene & Co., Greenville, S. C. Lighting intensity averages 60 to 70 footcandles.

Use of direct lighting in the drafting room, especially at lower intensities and where horizontal boards are used, has resulted in shadows along the drawing edge of T squares, triangles, etc., and multiple shadows from drawing instruments, or the draftsman's hands, as he works. It has also resulted in reflected glare from the specular surfaces of paper, T squares, triangles and scales. It was found that indirect lighting would minimize these objections, which has resulted in its widespread use. However, early installations were of much lower intensities than are accepted as standard today; so low, in fact, that it was difficult for the draftsman to see quickly and easily. The natural trend was therefore to increase the intensity of indirect lighting systems. In doing this, through the use of more units of higher wattage, new problems were introduced. Loads ranging upwards from five watts per square foot were found to develop enough radiant heat to become objectionable in summer months. Ceiling brightness, especially in long rooms and on flat ceilings, became objectionable in installations providing more than 50 footcandles.

Before the advent of fluorescent lighting, recessed coffer systems were adapted for lighting drafting rooms, and consisted of an indirect incandescent luminaire suspended from the center of the coffer. This technique eliminated the objection of the ceiling brightness to considerable extent, and was found to be fairly efficient. Except for the generation of an undue



Details of lighting techniques recommended for drafting room lighting. In detail A, low brightness 40 watt lamps may be used in reflectors or bare, above louvered ceiling. Detail B shows an all-luminous ceiling of low brightness, with glass angled to eliminate direct glare. Detail C shows a lighting technique suitable for use in open roof-truss area. A complete direct lighting system supplements a complete indirect system in detail D, and indirect troughs shield the direct lighting units.

amount of radiant heat, it was considered fairly successful. This technique provides, in effect, direct lighting from a large area, low brightness unit—the coffer itself.

Another technique which was developed to eliminate ceiling brightness in high footcandle installations was a "parabolume" metal ceiling. This ceiling was designed in the form of a parabola, with the surface of the parabola broken into steps to maintain a shallow depth to the reflector. An indirect incandescent luminaire formed the point source of light in this system, and was located at the focal point of the parabola. Light rays from the indirect luminaire were directed to the various parts of the ceiling and redirected straight down from any point of the metal ceiling reflector. Initial cost of this system, and the strong directional effect of the light, have been among the objections which have prevented greater adoption of this technique.

One technique often used in lighting drafting rooms with direct or semi-direct lighting systems has been to install continuous-row fluorescent equipment diagonally across the ceiling, to eliminate shadows from the drawing edge of T squares and triangles. The same result may also be obtained by locating the drawing boards and tables at an angle in the room. Neither practice is considered practical. In the case of diagonal installation of the lighting equipment, the cost is increased considerably, especially when equipment such as troffers is recessed in the ceiling. Angle mounting of drawing tables wastes floor space.

A fairly recent development in drafting room lighting is the use of an all-luminous ceiling. Some installations have consisted of flat panels of diffusing glass, above which reflectors are located to light the glass panels evenly. An objection to this type of lighting is direct glare, especially when the glass panels are truly diffusing in character and in long rooms with low ceilings where the ceiling comes down into the field of view. A refinement of this technique (B above) was used in the drafting room of one large electric

(Continued on page 158)

Combination of indirect and direct fluorescent lighting luminaires provides 65-70 footcandles in service in the Engineering Department of the Glenn L. Martin Company, Baltimore plane manufacturers.

ESTIMATES OF EXTENDED DURATION COSTS FOR ELECTRICAL CONSTRUCTION PROJECTS-INDUSTRIAL

(SEE NOTES BELOW)

ITEMS OF OPER. COST	I-$50,000.(SELL PR.) PROJ. BASE COSTS {MAT. 19,200. LAB. 12,800. EST. DURATION-5 MONTHS					II-$100,000.(SELL PR) PROJ. BASE COSTS {MAT. 40,800. LAB. 27,200. EST. DURATION- 7 MONTHS					III-$500,000.(SELL PR.) PROJ. BASE COSTS {MAT. 225,000. LAB. 150,000. EST. DURATION-15 MONTHS					IV-$1,000,000.(SELL PR.) PROJ. BASE COSTS {MAT. 450,000. LAB. 300,000. EST. DURATION- 20 MONTHS				
	NORMAL COST			EXT. TIME		NORMAL COST			EXT. TIME		NORMAL COST			EXT. TIME		NORMAL COST			EXTEN. TIME	
	THE JOB		PER MO.	COST/MO.		THE JOB		PER MO.	COST/MO.		THE JOB		PER MO.	COST/MO.		THE JOB		PER MO.	COST/MO.	
	%OF LAB.	$		%OF NOR	$	%OF LAB.	$		%OF NOR.	$	%OF LAB.	$		%OF NOR	$	%OF LAB.	$		%OF NOR.	$
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ESTIMATING	1.25	160.	32.	—	—	1.0	272.	39.	—	—	0.75	1,125.	75.	—	—	0.70	2,100.	105.	—	—
ENG.& PLANS-INCL. FIELD ENG.	2.75	352.	70.	20	14.	2.5	680.	97.	20	20.	2.0	3,000.	200.	20	40.	2.0	6,000.	300.	20	60.
FIELD SHOP & OFFICE	0.5	64.	13.	25	3.	0.4	109.	16.	25	4.	0.2	300.	20.	25	5.	0.2	600.	30.	20	6.
" TEL.	0.3	39.	8.	50	4.	0.2	54.	8.	50	4.	0.2	300.	20.	40	8.	0.2	600.	30.	40	12.
WIRING & POWER-FIELD	0.2	26.	5.	20	1.	0.2	54.	8.	12	1.	0.2	300.	20.	10	2.	0.2	600.	30.	20	6.
TOOLS-CONSUMED & DEPR.	3.5	450.	90.	20	18.	3.5	952.	136.	20	27.	3.25	4,875.	325.	20	65.	3.1	9,300.	465.	20	93.
TIME KEEPER-PRORATA EXP.	INCL. IN OH.			—	—	0.7	190.	27.	50	14.	0.7	1,050.	70.	50	35.	0.7	2,100.	105.	60	63.
SUPERVISION	2.75	352.	70.	60	42.	2.5	680.	97.	50	49.	2.5	3,750.	250.	50	125.	2.5	7,500.	375.	50	188.
COORD. DEL.-TO EXPEDITE LAB.	0.3	39.	8.	50	4.	0.2	54.	8.	50	4.	0.18	270.	18.	50	9.	0.18	540.	27.	50	13.
TRAVEL EXP-OFFICE TO JOB	0.25	32.	6.	50	3.	0.2	54.	8.	50	4.	0.15	225.	15.	40	6.	0.15	450.	23.	45	10.
INSURANCES & BENEFIT FUND	14.	1,792.	360.	—	—	14.	3,808.	544.	—	—	14.	21,000.	1,400.	—	—	14.	42,000.	2,100.	—	—
INTEREST ON PAYROLL	0.5	64.	13.	—	—	0.5	136.	20.	—	—	0.5	750.	50.	—	—	0.5	1,500.	75.	—	—
ASS'N. DUES	0.7	90.	14.	—	—	0.7	190.	27.	—	—	0.7	1,050.	70.	—	—	0.7	2,100.	105.	—	—
PRORATA CHARGES	0.3	39.	8.	50	4.	0.2	54.	8.	25	2.	0.2	300.	20.	20	4.	0.15	450.	23.	20	5.
INSPECTION & PERMITS	0.8	102.	20.	—	—	0.8	218.	31.	—	—	0.8	1,200.	80.	—	—	0.8	2,400.	120.	—	—
RES. FOR CONTING. & GUARNTEE	5.	640.	128.	—	—	5.	1,360.	194.	—	—	5.	7,500.	500.	—	—	5.	15,000.	750.	—	—
DIRECT JOB COSTS-LABOR	33.1	4,241.	845.		93.	32.6	8,865.	1,268.		129.	31.33	46,995.	3,133.		299.	31.08	93,240.	4,663.		456.
LABOR OVERHEAD	22.	2,816.	563.	50	281.	18.	4,896.	700.	45	315.	14.5	21,750.	1,450.	40	580.	13.8	41,400.	2,070.	40	828.
MATERIAL SERVICE, RES. & OH.	9% OF MAT.	1,728.	346.	20	70.	8% OF MAT.	3,264.	467.	20	93.	6.75% MAT.	15,188.	1,012.	20	202.	6% OF MAT	27,000.	1,350.	20	270.
TOTAL OPERATING COSTS		8,785.	1,754.		444.		17,025.	2434.		537.		83,933.	5595.		1,081.		161,640.	8,083.		1,554.
DIRECT LABOR INCREASE/MO.	4%				512.	2.85%				775.	1.33%				2,000.	1%				3,000.
INS. & BEN. FUND INCR./MO.					72.					108.					280.					420.
TOTAL COST PER MO.					1,028.					1,420.					3,361.					4,974.

LABOR BURDEN

NOTES:-

1- ESTIMATES ARE FOR "60/40" PROJECTS (BASE COST 60% MAT. & 40% LAB.) WITH $2.00/HR. LAB. & A 5 DAY WEEK.

2- RES. FOR CONTING. INCLUDES ALLOW. FOR INCIDENTALS, ADJ. FACTOR, ETC.

3- ESTIMATES INDICATE THAT DOUBLING THE NORMAL DURATION PERIOD WOULD INVOLVE AN ADDITIONAL EXPENSE OF APPROX. 10% OF THE CONTRACT PRICE. EACH MONTH WOULD BE IN PROPORTION.
EXAMPLE- COST PER MO. (EXTENDED TIME) FOR A $100,000. PROJ. (NOR. DURATION 7 MO.) WOULD BE APPROX. (10% OF $100,000.) ÷ 7 = $1428. (EST SHOWS $1420.)

4- DATA CAN BE USED FOR PROLONGED-DURATION PROJECTS

CHART I

ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO
R.A. 12-5-46

Volume-Duration Studies—Part V

By Ray Ashley

Research Engineer
Electrical Contractors Association
of City of Chicago

The value of analyzing completed project duration time as a business guide; also how to estimate anticipated prolonged-duration work.

TO direct his business toward the most remunerative channels, the electrical contractor must periodically make checkups on completed projects. Comprehensive checkups include a study of duration time. Research can produce figures which satisfy certain conditions, but each contractor must conduct his own studies to get data which are applicable to his type of business and methods of operating.

In Part III of this series (EC & M, Nov. '47, pg. 54, Chart 1) tables were presented which listed various costs resulting from extended duration. Part IV (EC & M, Dec. '47, pg. 55) described special cases where the listing and estimating of costs, shown in the tables, could be followed closely. For general estimating purposes, however, much modification of the figures is required.

Before discussing the subject of estimating the effects of time, let us establish some terms to facilitate explanation and avoid confusion. In Part IV we called the extra time for the special project "extended duration". Let us call the type of project dealt with an "Extended-Duration Project".

For identification we can call a project which one anticipates will be of longer than normal duration, a "Prolonged-Duration Project". With the latter term we must decide what to use as a gauge for normal duration. This can be explained as we elaborate on the two types of projects just named.

For the "Extended-Duration Project", we should review some salient points brought out in Part IV. Here a contract calls for the work to be completed in a given time. Through no fault of the contractor, the job runs much longer than the time stipulated in the agreement. Under such conditions the contractor is at a decided disadvantage. He has equipment and foremen tied up, and his whole organization must stand ready to serve the sudden demands of the job. *With little reduction in operating costs, he has a heavy reduction in volume.*

A job which the contractor anticipates will be completed in normal time, but runs much longer, is also a form of extended-duration project. In such cases, the expenses may not be as great as where a completion date is specified because the contractor is not trying to "push" the work.

On a "Prolonged-Duration Project", the contractor has many advantages which do not exist on an "Extended-Duration Project". *He anticipates the prolonged duration and plans his work accordingly.* Careful consideration of the following items may lead him, or his estimator, to anticipate such prolonged duration:

1. Seasonal weather conditions at time work is to be done
2. Availability of materials
3. Availability of competent mechanics
4. Possible progress of other trades on the project (based on past knowledge of general contractor's operations)

The number of foremen and first-class mechanics can then be limited to minimum job requirements and the maximum number of average workmen (not leaders) can be utilized. Only the tools and equipment necessary to

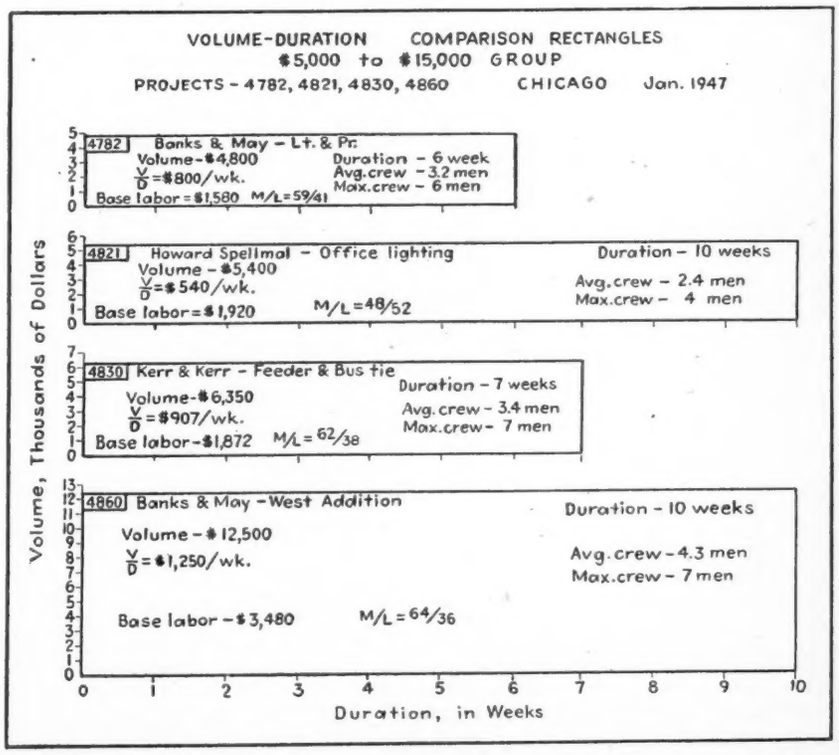


CHART II—Volume-duration rectangles give, in condensed form, relative comparison of how various jobs run. For complete analysis, employment curve should be plotted for each project to depict fluctuations which may have detrimental effects on other jobs.

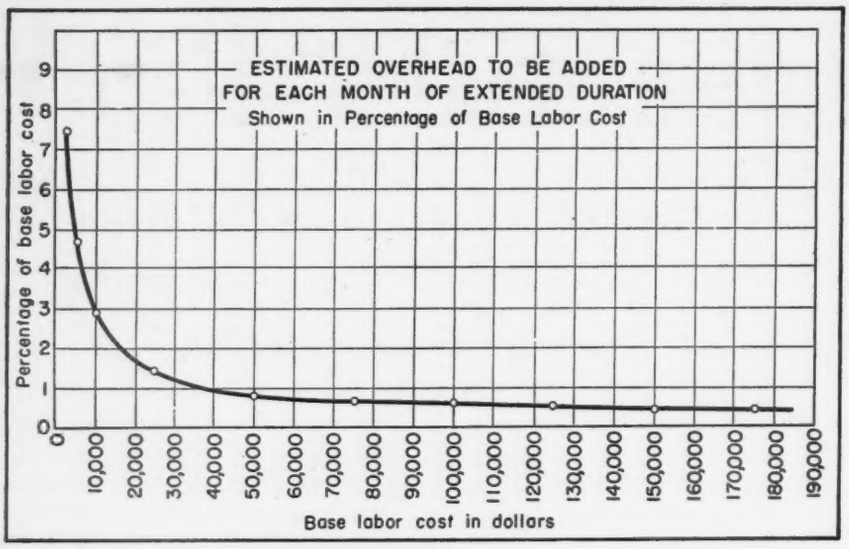


CHART III—By utilizing the above data, one can better estimate additional overhead costs on prolonged-duration projects.

maintain work progress are tied up. By anticipating job progress, engineering and superintending can be arranged to minimize interference with other work.

All other things being equal, abnormal duration will increase costs. Such costs can be determined only by experienced estimators. Even they seldom list them as separate items since they rarely think of any such intangible job factors as individual units. The aggregate effect of several such job factors is used for adjusting costs. Ability to make such adjustments is largely developed by analysis and studies of completed projects.

Study of Completed Projects

A study of the time element on commal duration will increase costs. Such formation. It frequently reveals that, what appear to be undesirable jobs on the books are really very good jobs poorly managed. Again, it may reveal that jobs which look good on the books are undesirable from the standpoint of the business as a whole. Too much should not be expected, however, from such studies.

When attempting to get detailed information on duration costs, one should not be surprised if, after much study, he seems to be getting no definite results. This experience is not unique. Studies of other job factors often result in the same conclusion.

Failure to get what seem to be tangible results should not deter the study of job factors and their effects on business. Regardless of the failure to produce definite figures, such studies aid much in getting the "feel" of the business. This is important. Sometimes figures are misleading, but the "hunch" of an experienced estimator is usually right. To obtain accurate results in estimating, data must be augmented with job studies and experience.

Chart II shows a simple approach to volume duration studies of completed jobs. Scaled rectangles are drawn with volume plotted against duration time. This method enables a contractor to readily visualize the relative proportions of various jobs. Preparation of the rectangles is only the beginning of the study. Management of the work and all job factors must be studied before any safe conclusions can be reached. The rectangle shows only the ratio of duration to volume. To complete the picture, the employment curve should be plotted to show whether the manpower demands were fluctuating or steady.

Excess duration may be the result of job conditions or it may be due to management. Lack of support from the office, mechanics not suited to the work, inadequate tools and poor delivery of materials, are among the many causes which may prolong the duration.

So called "on and off" mechanics are a common cause of prolonged duration. To satisfy fluctuating demands of other work, the contractor may periodically take mechanics off the job. These men work back and forth between the two jobs. We are all too familiar with the disruptive and costly effects of such practices.

In such cases, from the records on the books, the job from which the men were taken may appear to have been a poor venture. Had it been possible to hold the mechanics from start to finish, it might have proved to be a very worthwhile undertaking. The job with the fluctuating demands may have a good accounting on the books but, from the standpoint of the business as a whole, was not desirable. Analysis of completed projects could be discussed from many other angles, but such discourse would be too lengthy. Besides, the estimator learns all such details as he follows his jobs and studies completed work.

A word about regular accounts. A contractor may not be interested in studying the individual accounts of customers having several jobs a year. If the total billing is profitable, he lets that suffice. Any analysis of such accounts would be only for the purpose of increasing his general knowledge of the business.

The principal value of any job analysis and cost study, is to enable the estimator to figure his work accurately and the contractor to select his jobs carefully.

Estimating Prolonged-Duration Costs

When an estimator anticipates a project will be of abnormally long duration (Prolonged Duration) he must have a standard for deciding what is normal.

A contractor has his established costs for various types of projects completed in a given time. For his business, this time is normal and any marked deviation is abnormal. Most electrical contractors have labor units and operating cost percentages based on a mixed volume consisting of medium sized industrial and commercial accounts. For them, a club building or theatre with many changes in floor elevation and special architectural treatment would represent a job of abnormally long duration. A large rapidly moving industrial project would be one of abnormally short duration.

Many estimators automatically, and sometimes unconsciously, vary their standard of normal from time to time as the class of work they are doing changes. Others have basic labor units which serve as a standard for normal costs year in and year out.

Most estimators prefer to adjust their normal labor units to suit the particular job. They study the possibilities of the work and, in appraising

the effects of job conditions, weigh the time element along with all other factors which increase or decrease direct labor costs.

With duration period decided, direct labor costs figured, and general conditions well in mind, one is usually in position to accurately prepare job costs. When direct labor and direct job cost estimates are completed, the figures are usually reviewed before preparing overhead markups.

Any work which is irregular, requires special study of the final figures. As one studies the average and maximum manpower requirements, he may wish to change his manhours or adjust his hourly rate to cover additional cost of excess foreman time.

Excess overhead resulting from prolonged duration is often given little or no consideration. In some cases this may not be serious; in others sizable errors in estimating might result.

A basic discussion of this increased overhead percentage appeared in Parts III and IV. Therefore, only methods of estimating it will be covered here.

The individual contractor may have his own scheme for estimating overhead. He may use tables or curves. A curve similar to that shown in Chart III provides a quick means of establishing the approximate costs. A specific study will illustrate its use.

Take "60/40" industrial project with an estimated normal base labor cost of $30,000. The estimated job data would be about as follows:

Direct labor cost..	$30,000 (40%)
Purchased material.	45,000 (60%)
Job costs and mark-ups	30,000
Estimated sell price	$105,000
Optimum duration for well equipped contractor....	7.0 Months
Estimated duration	12.5 Months
Tolerance allowed (covered by reserve)..	1.5 Months
Estimated prolonged duration [12.5 − (7 + 1.5)]	4.0 Months

The curve shows the increased overhead costs ($30,000) to be 1.2 percent of labor. In dollars it would be 1.2 percent of 30,000 or $360.00 per month for an extended-duration project. For prolonged duration, since the job progress is anticipated, the contractor may feel justified in reducing this amount 20 percent. The cost per month then is:

$0.80 \times \$360.00 = \$288$ per month

For the job (4 month excess time) the total additional cost would be $4 \times \$288 = \$1152.00$.

Curves for prolonged duration should show percentages to be added to normal labor overhead. The amount shown by Chart III could be adjusted for prolonged duration by compensating two factors—job control, and markup for return.

To illustrate, let us make these two assumptions:

(1) By having anticipated the prolonged duration, the contractor can reduce the amount shown in Chart III by 20 percent.

(2) The markup for return in Chart III is 10 percent.

The multipliers would then be:

(a) For job control $(1.00 - 0.20) = 0.80$

(b) For markup $100/110$ ..... $= 0.909$ (use 0.91)

The final multiplier would be 0.8×0.91 ..... $= 0.728$ (use 0.73)

Applying this adjustment factor to the 1.2 percent shown for a $30,000 base labor project, we have $0.73 \times 1.2 = 0.876$. This is the amount to be added for each month of prolonged duration. For four months we would have $4 \times 0.876 = 3.5$ percent. Applied to $30,000, the resultant cost would be $1050.00. This is the cost without return.

To get a figure comparable with that previously established, we must add the 10 percent for return:

$\$1050 + 10$ percent $= \$1155.00$

The figure we previously established was $1152. The $3.00 difference is a result of slight adjustments in percentages used.

You will note that the overhead cost of prolonged duration has all been based on labor. This is the safest and simplest method to use. We learned

(Continued on page 164)

ESTIMATED COSTS OF EXTENDED DURATION FOR ELECTRICAL CONSTRUCTION PROJECTS

	I—COMPLETE INSTALLATIONS			II—INSTALLATION-ONLY PROJECTS			
SELL PRICE OF PROJECT IN DOLLARS	EST. DURATION IN MO.	COST PER MONTH % OF SELL PRICE	COST PER MONTH IN DOLLARS	APPROX. VOL. OF A COMPL. PROJECT (CONTR'S ESTIMATE)	EST. DURATION IN MO.	COST PER MONTH % OF SELL PRICE	COST PER MONTH IN DOLLARS
10,000.	3	3.3	330.	21,000.	5	6.6	660.
25,000.	4	2.5	625.	53,000.	7	4.75	1,190.
37,500.	4.5	2.2	830.	82,000.	8	3.75	1,400.
50,000.	5	2.0	1,000.	108,000.	9	3.33	1,670.
75,000.	6	1.67	1,250.	160,000.	12	2.55	1,910.
100,000.	7	1.42	1,420.	213,000.	13	2.30	2,300.
150,000.	9	1.11	1,665.	310,000.	15	1.85	2,800.
200,000.	10	1.0	2,000.	405,000.	18	1.67	3,350.
300,000.	12	0.89	2,670.	605,000.	20	1.52	4,550.
400,000.	14	0.72	2,880.	810,000.	23	1.40	5,600.
500,000.	15	0.67	3,360.	1,030,000.	24	1.28	6,400.
600,000.	16	0.63	3,780.	1,225,000.	27	1.23	7,400.
750,000.	18	0.56	4,175.	1,550,000.	28	1.20	9,000.
1,000,000.	20	0.50	5,000.	2,050,000.	29	1.15	11,500.
1,250,000.	22	0.46	5,750.				
1,500,000.	23	0.44	6,600.				
2,000,000.	24	0.42	8,400.				

NOTES:-

ESTIMATES BASED ON INDUSTRIAL PROJECTS WITH 60% MAT. & 40% LABOR (BASE COSTS), 5 DAY WEEK, AND 2.00 PER HR. LABOR.

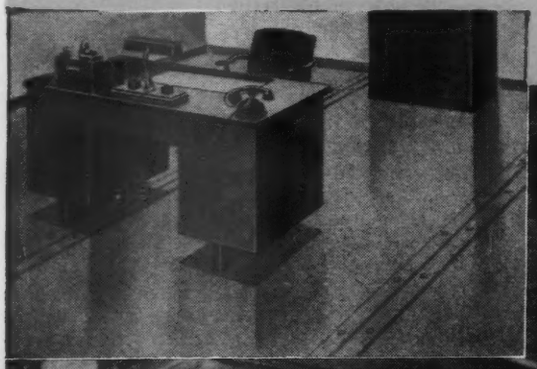
ELECTRICAL CONTRACTORS' ASS'N. R.A. OF CITY OF CHICAGO 12-10-46

CHART IV—Extended-duration costs are greater for installation-only projects than when contractor has complete control of job. Loss of material control reflects certain loss of labor control.

Nepcoduct

FOR CONVENIENCE OUTLETS IN THE FLOOR

An Electrical Raceway made of STEEL for *PERMANENCE*— thoroughly GROUNDED for *SAFETY*



Nepcoduct is a steel raceway system complying with the requirements of the National Electrical Code and approved by the Underwriters' Laboratories, Inc. It is a professional material for lighting, power, telephone and signal services.

Pre-determined outlets will provide abundant service for desks and free-standing equipment.

- A new simplified duct of ONE standard size—1⅜" x 2⅞"—for both high and low potential runs. A 60% reduction in fittings.
- Eliminates confused specifications—easier to understand . . . easier to order . . . easier to install . . . easier to maintain.
- Outlets may be closed and re-opened without disrupting office routines. No fuss . . . no muss.
- Installed without excess labor or interference in all types of conventional floor construction.

Nepcoduct The STEEL Underfloor Distribution SYSTEM

(Left) Low potential service fitting. *(Right)* High potential service fitting. Streamlined design—brushed brass finish—simple, strong construction.

One standard-size duct—smooth, welded construction—rounded corners, for strength in floor construction.

STEEL *for Permanence...*

GROUNDED *for Safety*

- Let us send you complete information. Call our sales office nearest you, or write to the address given below.

National Electric Products Corporation
Pittsburgh 30, Pa.

EVERYTHING IN WIRING POINTS to—

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

Mobile service unit is equipped with two-way radio-telephone so that driver can remain in constant touch with the main office. George Rosner, in charge of the S. J. O'Brien truck, checks list of materials on standard requisition form with dispatch clerk at central plant prior to proceeding to customer requesting service.

Radio-Telephone Unit Speeds Mobile Service

MAINTENANCE

In the interest of rendering faster service to approximately 250,000 Frigidaire owners on the island of Manhattan, the S. J. O'Brien Sales Corporation of New York City has inaugurated radio-telephone communication between their central plant office and one of their mobile refrigeration service trucks. Results achieved during the first few months of operation have demonstrated the advisability of increasing this type of service and additional units are now on order.

The communications equipment mounted in the truck consists of a two-way radio-telephone system complete with transmitter and receiver. A French-type phone, held securely in a special cradle rest when not in use, is the medium for transmitting and receiving information. With the depressing of a button on the hand grip, the unit operates as a transmitter. With the phone in its cradle and the button in its normal, raised position, the equipment operates as a receiver. Operating on the 152 to 162 megacycle band, the unit is crystal controlled, frequency modulated for high quality transmission, and is effective within a radius of 30 miles. Contact between truck and central office is established through the mobile division of the New York Telephone Company which acts as a central transmitting and receiving station for the many radio-telephone cars operating in the metropolitan area. A direct line connects this mobile division to a special dispatch desk in the O'Brien office where a bell and light signal indicates incoming calls. As is generally practiced in radio communications, call letters are used in establishing contact.

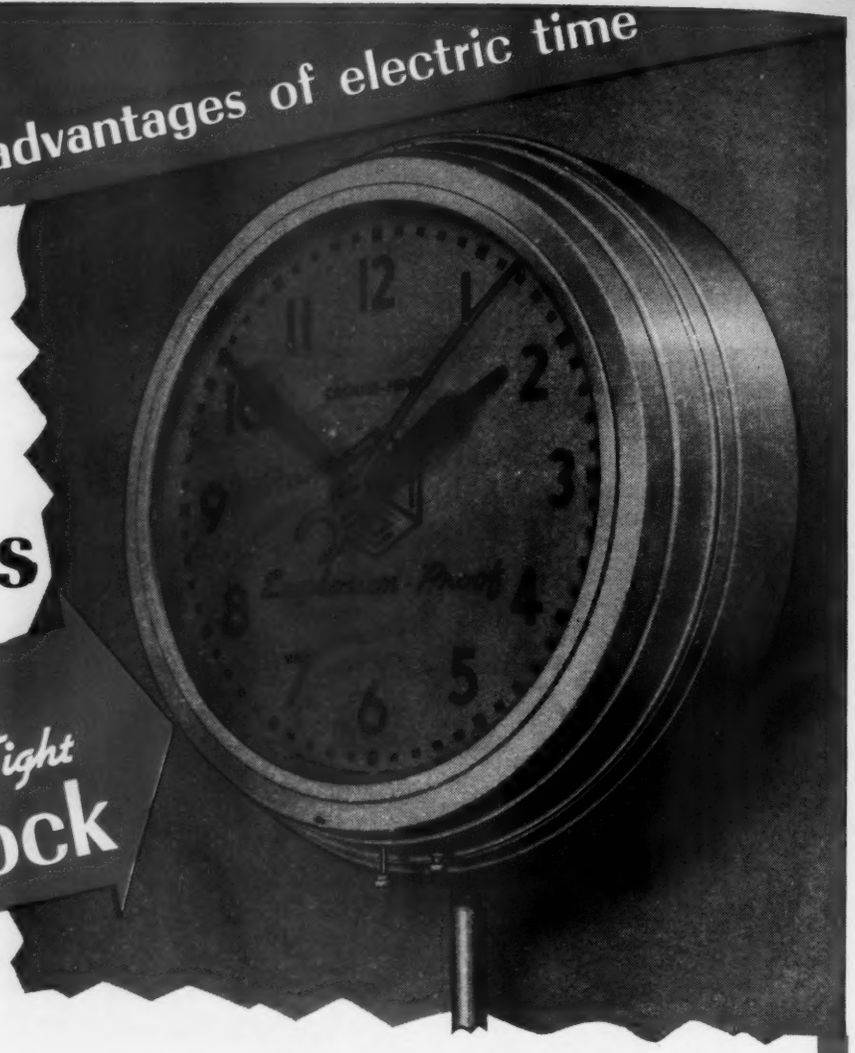
In operation, either the office dispatch officer or the service truck operator can initiate a call by lifting their respective phone from its rest and giving the required call letters to the operator in the Telephone Company's mobile division office. The Telephone Company's division office is in contact with the truck by radio and with their customer's office by direct telephone. Communications between maintenance office and truck is expedited by training both the driver and the dispatch officer in approved radio procedure. Standard requisition forms are used by both parties and information for these forms is requested and given in a standardized routine so that the possibility of error or misunderstanding is minimized.

With a quarter-million Frigidaires involved in the maintenance and service picture, the O'Brien refrigeration service department found it necessary to create zones throughout the metropolitan territory, with each zone staffed with sufficient service men and supervisors to handle emergency calls, and with local warehouses to keep replacement parts in the approximate vicinity of the units requiring maintenance and repair service. To effectively cover the area, each service man formerly drove his own car. With the limited carrying capacity of these smaller cars, many daily trips were necessary between a customer's premises and either the local warehouse or the main plant for required spare parts and equipment. At present, an emergency call from a customer summons a repair man who inspects the defective equipment, analyzes the trouble, and phones his report to the main office. The operator of the mobile service truck is notified, by radio-telephone, of the required parts and proceeds immediately to the job site. Meanwhile, the repair man disconnects and removes the defective parts or unit so that, upon the arrival of the truck, no time is lost in making the required substitutions and re-establishing refrigeration service.

Service is now faster and more efficient. Local warehouses are unnecessary. Time is saved. Food, also, is conserved, since there is less likelihood of spoilage in refrigerators while await-

NOW you can have the advantages of electric time in hazardous locations with CROUSE-HINDS NEW

Explosion-Proof and Dust-Tight Electric Clock



Safety. Crouse-Hinds Electric Clock is safe to use in locations where explosive atmospheres are likely to be present.

Easy to read. This large electric clock has a dial 13 inches in diameter scientifically designed for easy reading. The face is satin finish aluminum with numerals, hour and minute hands in jet black, and a sweep second hand in brilliant red.

Attractive case. Finished in metallic gray enamel.

Easy to maintain. Can be taken apart in a jiffy .... without special tools. Can be reset without opening the case.

Small housing. The motor and all electrical connections are enclosed in an explosion-proof CONDULET* housing only 5-3/4 inches in diameter.

Two styles. The clock is furnished in two styles One is for flush mounting where concealed conduit is used. The minimum depth required for the CONDULET in the wall is 3-1/2 inches. The other style is for surface mounting where the conduit is on the surface of the wall. Either style can be flush mounted on a panel.

Adjustable. The CONDULET body can be mounted for either vertical or horizontal conduit connection.

Listings on new Page 12J, Section 85, CONDULET Catalog 2500.

Crouse-Hinds complete line of thousands of CONDULETS includes a cast outlet for every purpose in ordinary and hazardous locations.

**CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.*

A Nationwide Distribution Through Electrical Wholesalers

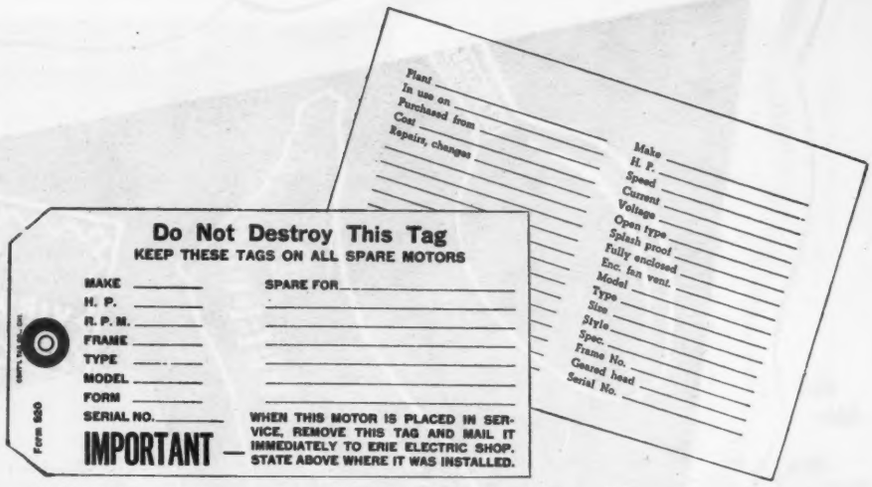
CONDULETS
FLOODLIGHTS
TRAFFIC SIGNALS
AIRPORT LIGHTING

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

Offices: Birmingham – Boston – Buffalo – Chicago – Cincinnati – Cleveland – Dallas – Denver – Detroit – Houston – Indianapolis Kansas City – Los Angeles – Milwaukee – Minneapolis – New York – Philadelphia – Pittsburgh – Portland, Ore. – San Francisco Seattle – St. Louis – Washington. *Resident Representatives:* Albany – Atlanta – Charlotte – New Orleans – Richmond, Va. CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

ing the speeded service. The parking problem has been eliminated, because the truck can unload quickly in front of a customer's service entrance rather than park out of the city's numerous restricted traffic areas.

Since the mobile radio-telephone service unit carries a complete assortment of all replacement parts, large tools and refrigerants, the service man can cover his area with a small tool kit and proceed from job to job on foot or by local transportation facilities. The completeness of stock carried in the radio-telephone truck is indicated by referring to the standard stock list which includes such items as belts, brushes, fuses, relays, strainers, gaskets, motors, floats, gas masks, test cords, gauges, dryers, sylphons, drums of refrigerants, pulleys, switches, plugs, pigtails, solder and solder paste, commutator stones, tie wires, rags, flashlight batteries and bulbs, cleaning brushes, thermometers, copper tubing, work order pads, extra pencils, belt adapters and snubbers. Parts, equipment, tools and motors are carried in metal bins which line both side walls of the truck.

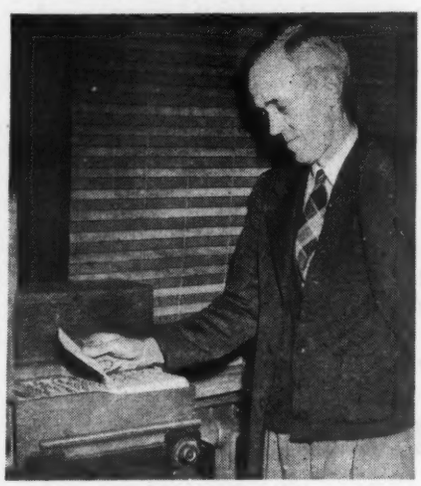


Printed tag that is attached to each of the 400 spare motors located in some 39 Bowman Dairy Company plants. Nameplate data is inserted at time of attachment; application data when motor is installed.

Keeping Tabs On Spare Motors

MAINTENANCE

By the simple expedient of using printed tags, Paul E. Patrick, chief electrician, Bowman Dairy Company, Chicago, is able to maintain a centralized record control of spare motors in some 39 Bowman plants located within a 150-mile radius of Chicago.



Motor file card kept at the electrical maintenance headquarters in Chicago. Some 3,000 of these comprise the master file of all motors installed in Bowman plants.

Chief electrician Paul E. Patrick shows how all spare motors are tagged before they are placed on maintenance shop shelves in various Bowman Dairy plants. Tags are mailed to his office when motors are placed in service. Master cards, filed according to plant, are changed whenever a spare motor tag is received at maintenance headquarters. Complete file is kept up to date at all times.

As head of the electrical maintenance department, Mr. Patrick is responsible for the operating condition of electrical systems in all plants. Under his guidance, an inventory of some 400 spare motors has been built up, as well as a substantial stock of magnetic starters and other control accessories. Each plant stocks its share of this total, usually one spare motor for each important drive up to 20 hp. in size. When a motor fails, a spare is connected and the damaged unit sent out for repair. Thus, such important units as circulating water, milk and cream pumps, conveyors, bottle washers, bottle filling machines, refrigeration units and others can be kept operating.

Master records of all operating and spare motors in all plants are kept in the Chicago office of the electrical maintenance department. Each spare motor in each plant bears a printed tag as illustrated above. On it is given the essential nameplate data of the unit. These remain on the motors until they are put into service. The tag is then removed, the application data added (when, at what plant, and on what machine or process it was installed), and mailed to the Chicago electrical shop. Immediately upon receipt of a tag, Mr. Patrick changes his master file record accordingly.

When motors sent out for repair are returned to the plant, a new tag is attached. The process is repeated when this unit again goes into service. Thus, the chief electrician is able to keep tabs on any motor replacement or change that occurs in any plant, whether it be within one or 100 miles of the central headquarters. As Mr. Patrick observes, "Our electricians know the importance of this tag scheme and have cooperated so well that, to date, we haven't lost a motor."

Smoke Removed by Precipitators

AIR CONDITIONING

Electronics has entered Madison Square Garden, New York. Not as an exhibit, but to remove tobacco smoke and cleanse the air. This is accomplished by one of the largest installations under one roof of electrostatic precipitators, made by Raytheon Manufacturing Company, Waltham, Massa-

that's why you benefit by insisting on a *Certified* starter

CERTIFIED on a starter is like STERLING on silver, 100% VIRGIN WOOL on a label, or U.S. PRIME on beef—it is your assurance of tops in quality.

To get the best lighting performance and to get the greatest economy in maintenance of your fluorescent installation, insist on CERTIFIED starters.

Here's why you'll benefit: CERTIFIED starters meet rigid specifications for performance and service. They're *Certified* by Electrical Testing Laboratories, Inc., after testing and checking. You get longer lamp life and longer starter life with CERTIFIED starters.

CERTIFIED
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SPEC. NO. 6

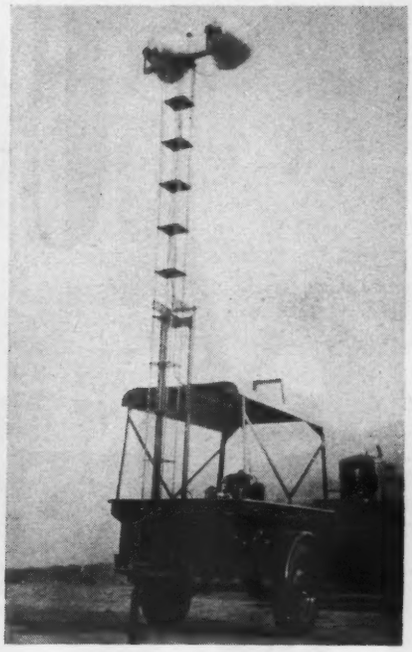
To be sure you get the best, look for the CERTIFIED shield on the case and on each starter.

Address inquiries to any of the following manufacturers of

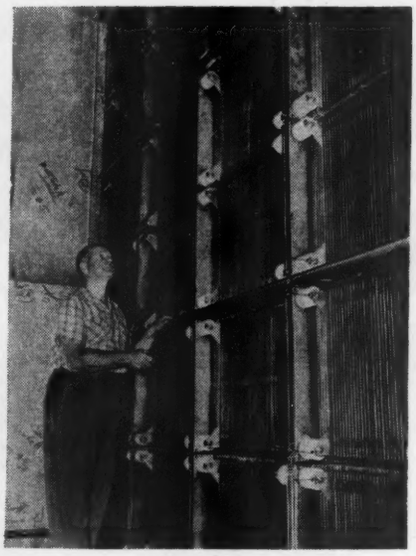
Certified Starters

The Arrow-Hart and Hegeman Co., Hartford, Connecticut
The Bryant Electric Co., Bridgeport, Connecticut
Dura Electric Lamp Co., Newark, N. J.
General Electric Co., Bridgeport, Connecticut
Harvey Hubbell, Inc., Bridgeport, Connecticut
Instant Glow Starter Corporation, New York, N. Y.
Kuthe Laboratories, Inc., Newark, N. J.
The Lloyd Products Co., Providence, R. I.
Pass & Seymour Co., Syracuse, N. Y.
Sheldon Electric Co., Irvington, N. J.

General John Reed Kilpatrick, president of Madison Square Garden, pushes the starting button for the new air conditioning system. Raytheon precipitators are automatically turned on with the air conditioning to remove smoke and dust from the air.



Two floodlights atop the 18-foot steel tower provide illumination for night construction. Design of trailer unit provides perfect balance.



Howard Post, chief engineer at the Garden, inspects the collector cells of the precipitator. Positively charged particles as small as 1/250,000th inch, including the particles of tobacco smoke, are directed to the plates of the collector cell, cleansing the air.

chusetts, and operated in conjunction with the new air conditioning system in the Garden. Now spectators at the Garden can enjoy the many sporting events and spectacles in greater comfort than that provided in any comparable indoor place of amusement.

The new air conditioning system supplies air which is cooled in the summer and heated in winter and is also corrected for humidity. Climatic conditions are excellent and drafts have been eliminated. All air passes through the precipitators where the removal of dust, dirt and smoke is accomplished.

The electrostatic method of dust precipitation means that all airborne particles are carried through an electrostatic field. Particles become charged and are precipitated onto collector plates alternately charged with high positive voltage. The electronic air cleaner attracts particles so small that millions can cover the head of a pin. Smoke particles, of this minute size, are effectively removed when carried through the units.

The air conditioning system in the Garden comprises eight individual systems, each handling 67,500 cubic feet of air per minute, or a total of 540,000 cfm. The precipitator installation also comprises eight units, each having 30 cells and ironizers. The cross section area of each bank of precipitators is 13-by-15-feet. These are installed in the duct work between the dehumidifiers and the fans, in such a manner that all of the air supplied to the Garden passes through the electronic filters. The filters remove 85 percent of all particles as small as 1/250,000th inch.

The installation will not only improve the comfort of spectators but will also reduce eye strain to a minimum since those sitting in the mezzanine or balcony will no longer have to look through a smoke haze. Athletes participating in sporting events will also be benefited by breathing air free from smoke.

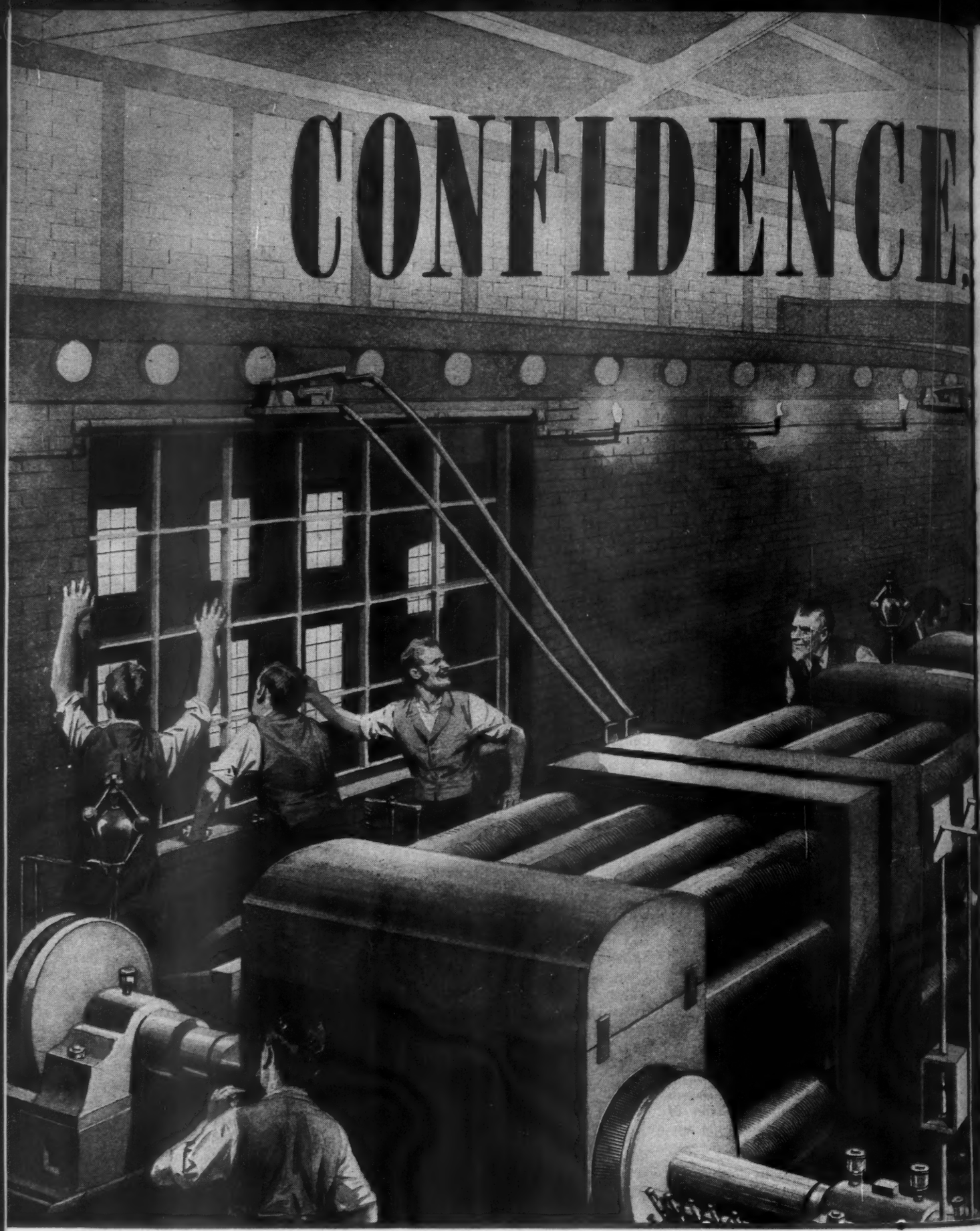
Mobile Floodlights Mounted on Trailers

ILLUMINATION

To provide adequate lighting for night construction projects, the Arrow Supply Company of Pittsburgh developed a portable 3000-watt light tower and generator rig. Mounted in ½-ton all-steel Bantam utility trailers, these new lighting outfits are being used on some of Pennsylvania's state highway projects, in connection with mining and night construction.

The welded steel tower operates on a hinge fastened to the trailer canopy. On top of the tower are two 1500-watt clear globes in reflectors. When erected, the tower is 18 feet in height; when folded, it has approximately 9 feet road clearance. The lights are pivot mounted and have adjustable beam and spread.

Welded to the steel bed of the trailer is a gasoline-powered generator with five-gallon fuel tank. The generator can be started automatically, providing a-c power for the lights almost instantly. A 12-volt circuit for battery charging is also located on the truck frame. The total weight on the trailer is approximately 900 pounds. Trailers, of sturdy welded construction and with long springs and standard passenger car tires, are designed so that they are balanced either when in motion or when stationary and resting on the front leg support.



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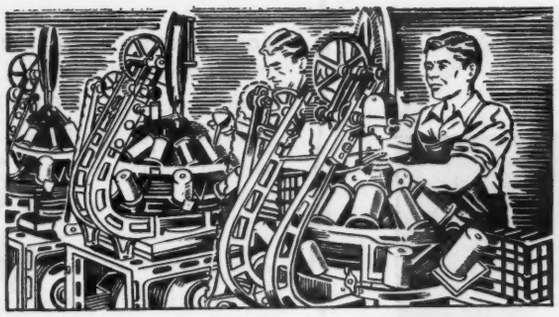

IN 1880, when electric lights first were tried on New York's Broadway, Roebling's confidence in the future of electricity motivated a new Roebling undertaking . . . the manufacture of electrical wire and cable.

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At the right is a listing through which your nearest Roebling Field Man can be contacted. Why not call or write him today? Make an appointment to meet a friend who can save you both time and money.

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Denver	1635 Seventeenth St. . . . East 2684 & Keystone 4111
Houston	6216 Navigation Blvd. . . . Woodcrest 6-8316
Los Angeles	216 S. Alameda St. . . . Trinity 1261
New York	19 Rector Street . . . Wh. 3-5200
Philadelphia	12 S. 12th Street . . . Market 7-2751
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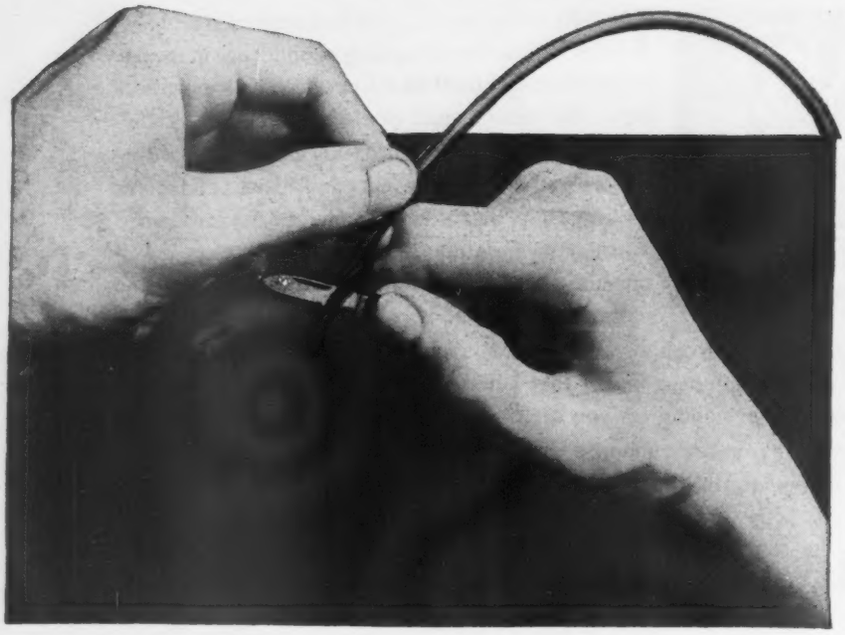

You can try it yourself if you're a skeptic. Notice the clean cut and the free break-away that means a "happy ending" as you strip a piece of General Electric's thermoplastic building wire. Compare the time — and the result — with any other insulation. Then figure it all in *time on the job.*

While you're at it, reassure yourself on the abuse that General Electric thermoplastic will take, back of the stripped end. Twist it! Scrape it! Try to burn it, if you like — General Electric thermoplastic may char, but it will not support combustion.

Of course, the real cost-saving advantages of this modern type of building wire begin to register when you use it on the job. It saves time by pulling easily. It has made possible building wires of small diameter, without lowering insulation standards.

Because General Electric was first in introducing thermoplastic wire, it has always been first in the experience necessary to make the uniform, well-centered, fully tested Types T and TW wires that are attracting new users so rapidly today. You don't have to take our word for it . . . try this modern wire for yourself. Write for a sample — and more facts — to Section W56-118, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

Thermoplastic
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LOOK AROUND the next time you call on an industrial customer, and you'll notice dozens of uses for heavy rubber-jacketed cords. Notice the variety of electric equipment that requires this type of cord. Looks like good business . . . and it is, both in volume and profit. General Electric makes rubber-jacketed cords in many sizes and constructions. They are built for long service and outstanding performance. We'll be glad to tell you more about them.

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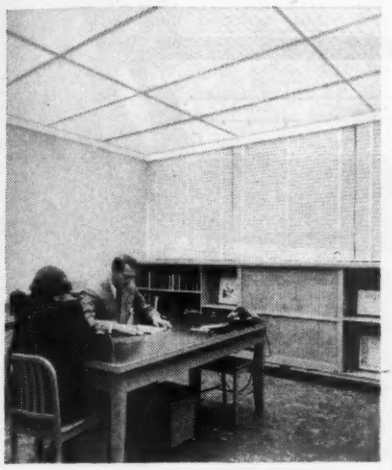
SPECIAL WIRING JOBS call for wires and cables made for special service. In the big family of General Electric wires and cables, you will find rip cords, shot firing cords, bus drop cables, telephone wire, brewery cords, fixture wires, and dozens of other types for virtually any application. Let us help you pick the right wire for that next unusual installation.

*Trade-mark Reg. U. S. Pat. Off.

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONSTRUCTON and MAINTENANCE you saw the item and they will send full details to you.

Equipment News



Louver Ceiling

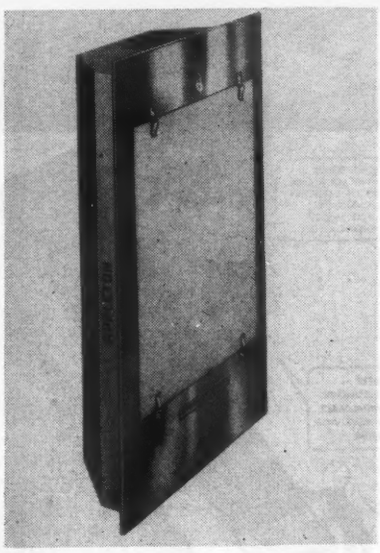
The "Sky-Glo" lighting system is a new luminous louver ceiling development. Through this system, it is possible to convert the entire ceiling into a lighting unit, with the louvers glowing with light. It consists of standardized stock sections of louvers, channels, and fittings. Louvers are made of Vinylite and have a light transmission factor of approximately 60 percent. There are four sizes of louver sections, which make possible geometric arrangements providing wide flexibility of design for various sizes of ceilings. Benjamin Electric Mfg. Co., Des Plaines, Ill.

Outlets

A simplified Nepcoduct system is now available and among the innovations is a 1½ inch standard pipe threaded outlet. This outlet has a steel wall thickness to permit a standard pipe thread of sufficient length for good mechanical and grounded connection. The coarse threads permit desirable tolerances with assurance against thread stripping. This feature is said to be particularly important on industrial installations of underfloor duct where conduit nipples are used in a run to the disconnect-switches, or to machinery splice boxes. The system incorporates a single size 14 gauge steel underfloor duct, 1⅝ inches by 2⅞ inches. Nepcoduct is supplied in 10 feet lengths and is available with either black enamel or Sherardized rustproof finish. National Electric Products Corp., Chamber of Commerce Bldg., Pittsburgh 19, Pa.

Connectors

Two new non-metallic sheathed cable connectors are available. No. 1212-A is an expansion type cable connector for use on 14-2, 12-2, 14-3 and 12-3 conductor non-metallic sheathed cable. These connectors are the expansion type and are constructed of one piece of metal, eliminating any separate clamping member piece. They can be easily and quickly installed, it is claimed. The construction of Connector No. 912 is basically the same as the No. 1212-A except smaller. Hagen Manufacturing Company, Inc., 1440 Blair Ave., St. Louis 6, Mo.



X-Ray Film Illuminator

The Type "EFUX" explosion-proof X-Ray film illuminator is designed for flush mounting in hospital operating rooms. The handle of the explosion-proof switch extends through the upper part of the panel, within convenient reach of the operator. Chrome-plated spring clips hold the glass and X-Ray film in place. A threaded hub for ¾ inch rigid conduit is provided in bottom of cabinet. To relamp, remove switch handle, loosen the cover screw and remove glass cover panel. Tip fixture out of the cabinet by releasing tension of spring clip, then remove screw cover and pull out lamp. Appleton Electric Company, 1701 Wellington Avenue, Chicago 13, Ill.

Mercury Lamp

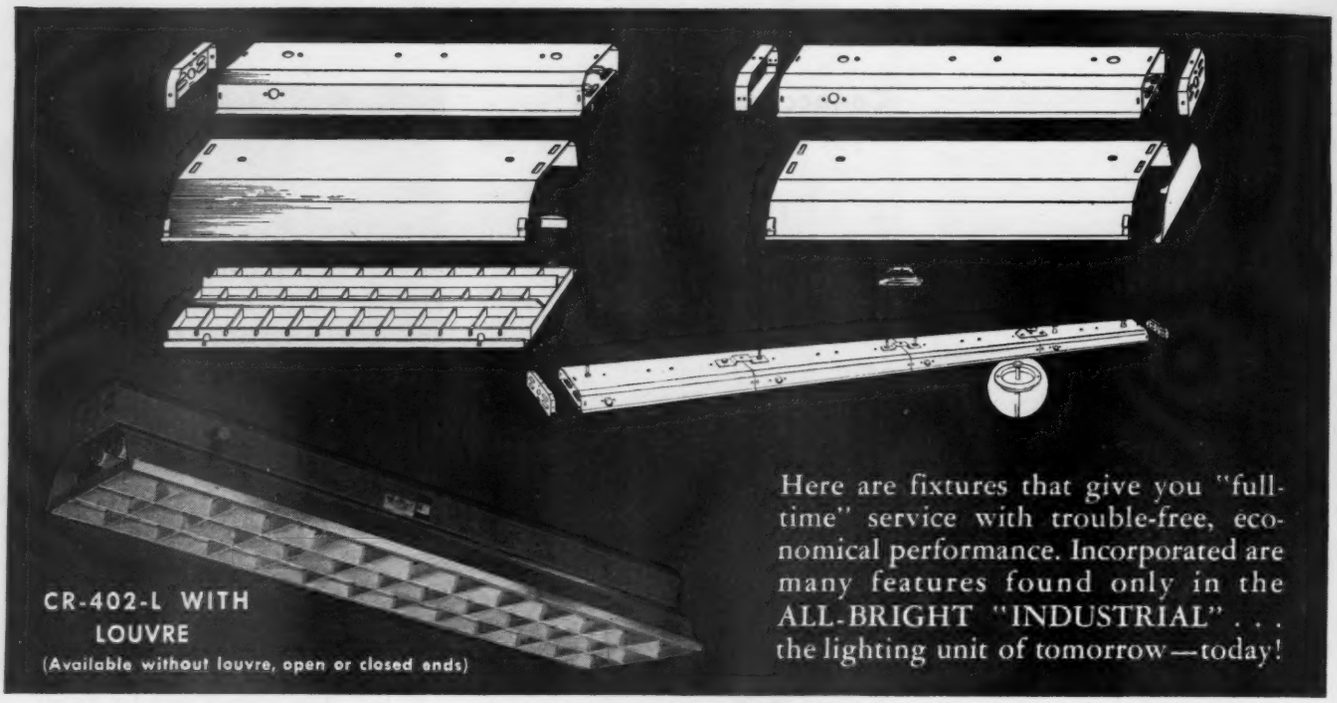
A new A-H5 mercury lamp of improved design which may be used for black light, street lighting and all other general lighting applications in which mercury lamps are desirable, has been announced. The new lamp replaces both the former A-H5 and C-H5 lamps. It is used with a transformer. It may be used in all existing equipment as there is no change required in auxiliary or fixture dimensions. When used for black light applications a filter, usually black glass must be used. It is rated at 250 watts and has a maximum outside length of 8 inches. In addition to general industrial lighting in manufacturing plants over assembly lines, foundry and machine shops, the new lamp is particularly useful in gasoline service stations, for flood lighting, for garden lighting, for exhibitions, expositions and for street lighting. General Electric Company, Nela Park, Cleveland 12, Ohio

Insulating Nipples

Sali insulating nipples are now available in lengths from ¾ inch to several feet, and in pipe sizes from ¼ inch to 6 inches. Used in conjunction with Sali insulating bushings, they are ideal for providing an insulated raceway through walls or castings. They are suitable for breaking thermal flow from refrigerated areas, and can serve as insulating joints in pipe lines to eliminate electrolysis. They are machined from a laminated phenolic material. Adalet Manufacturing Co., 14300 Lorain Ave., Cleveland 11, Ohio

Designed FOR INDUSTRY—

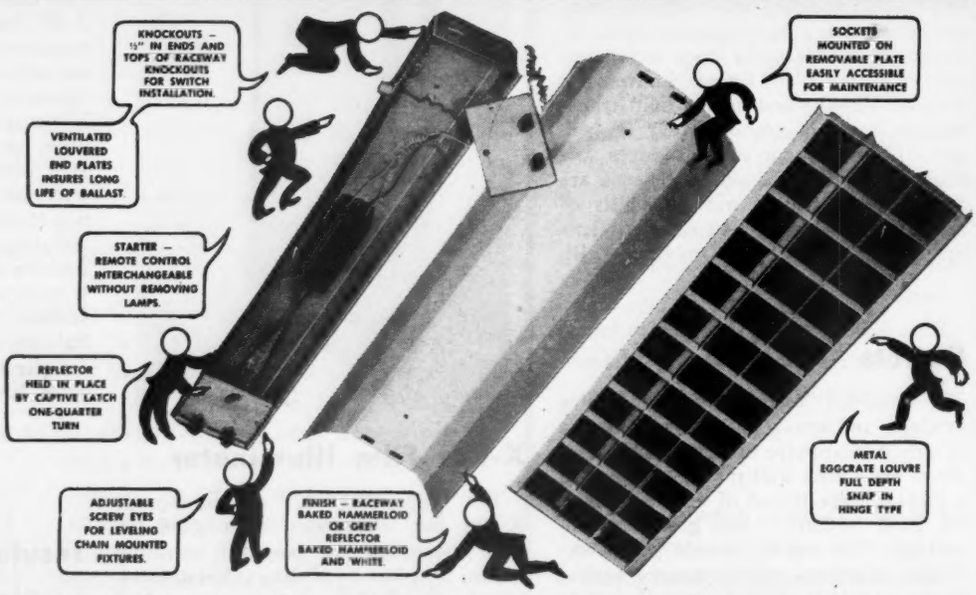
ALL-BRIGHT'S CR SERIES INDUSTRIAL LUMINAIRES



CR-402-L WITH LOUVRE
(Available without louvre, open or closed ends)

Here are fixtures that give you "full-time" service with trouble-free, economical performance. Incorporated are many features found only in the ALL-BRIGHT "INDUSTRIAL" . . . the lighting unit of tomorrow—today!

To assure accurate alignment of lamps, removable lamp-holder plates have been created for easy maintenance without removing fixture from the outlet. The louvred ends assure longer life of the ballast. Remote starter control. The reflector is made of sturdy heavy gauge steel, finished in Hammerloid and baked white or porcelain enamel — and is removable by one-quarter turn of captive latch.


KNOCKOUTS — ½" IN ENDS AND TOPS OF RACEWAY KNOCKOUTS FOR SWITCH INSTALLATION.
VENTILATED LOUVERED END PLATES INSURES LONG LIFE OF BALLAST
STARTER — REMOTE CONTROL INTERCHANGEABLE WITHOUT REMOVING LAMPS.
REFLECTOR HELD IN PLACE BY CAPTIVE LATCH ONE-QUARTER TURN
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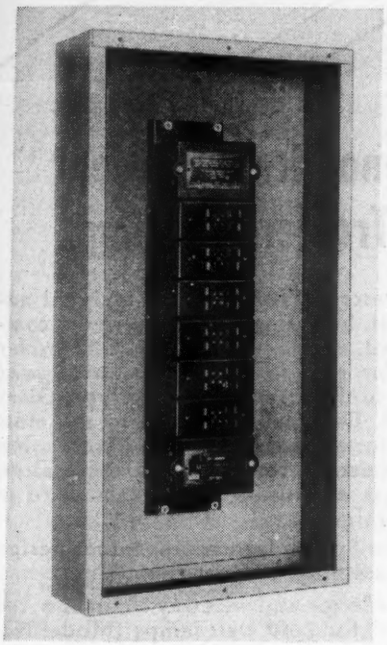
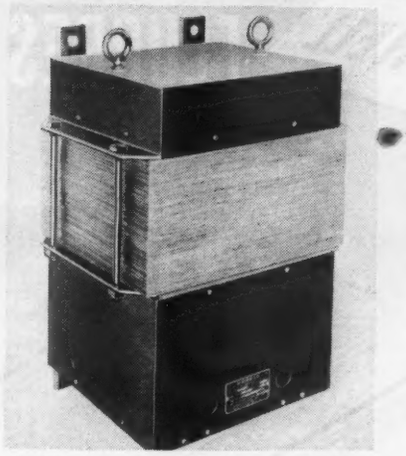
Plug-In Panelboard

Improved utilization of space on walls and columns is a feature of this new plug in panelboard with thermal (coilless) magnetic multibreakers. Due to the small size of the M04 multi-breaker units, this panel affords increased gutter space (5½ in. gutters in 15-in. wide panelboard). The narrow, column type provides twice the number of circuits previously available in cabinets of similar size. The plug-in feature permits easy and speedy removal or insertion of multi-breaker units for future changes in circuit ratings or for additional circuits. Breaker units are mounted on silver-surfaced bus bars. Units provide four single poles which can be converted into two double poles by the insertion of handle ties. They are furnished in 100 and 200 ampere main ratings, 120/240 volt a-c with 15, 20 and 30 ampere branch circuits. Square D Company, 6060 Rivard Street, Detroit 11, Mich.



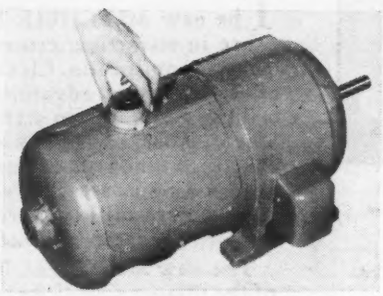
Motor

Designed to maintain constant maximum torque at all speeds, this new variable speed motor is variable from 1500 to 6000 rpm., giving adjustable, step-less speed control. A lever at the side of the motor stops and starts the motor and mechanically controls a pair of centrifugal vibrating contacts which accomplish the speed variation. Completely self-contained, it is recommended for precision drilling, grinding, buffing, polishing, chemical mixing, wire or tape winding, utility and general laboratory work. The motor is 1/5 hp., ball bearing, universal wound, reversible, 115 volts, single phase, any frequency, and is approximately 9 by 7 by 5 inches. Guernet Electrical Machinery, Incorporated, Box 196, Meriden, Conn.



Power Circuit Transformer

These power circuit transformers are of the air-cooled, dry type and designed for the operation of control apparatus from the power circuit, supplying 115 or 230 volt circuits from a primary voltage of 575 or 460/230. They operate on either 50 or 60 cycles and have capacities up to 37½ kva., single and three phase. The transformers operate on any of the rated voltages up to 600 volts. Dongan Electric Manufacturing Company, 2985 Franklin Street, Detroit 7, Mich.



Induction Motors

A new line of Tri-Clad brush shifting adjustable speed induction motors, Type ACA, has been announced. Available in ratings from 3 to 50 hp., 220, 440 and 550 volts, the motor features stepless speed adjustment over a 3:1 ratio by turning a dial. The entire unit, with the exception of the starter control, is self contained. Remote speed control can be accomplished by use of a flexible cable shaft up to 10 ft. away from the motor. For complete remote control, a small pilot motor can be used to drive the speed control mechanism. Applications include driving textile machinery, draft fans, stokers, small paper machines, wire drawing machines, laundry flat work ironers, dough mixers, cement kilns, stamping presses, and pumps. Motor is rated on a constant torque basis. For intermittent use, speeds below minimum rated may be obtained by adding secondary resistance. General Electric Company, Schenectady, N. Y.

Wiring Technique

The new Wire-Hiway base, despatcher model, trims, provides wiring facilities and anchors partitions. Four screws in rear member will erect as much as 10 feet complete, it is claimed. No splicing plates or screws to mar front panel. Made of extruded aluminum, it is 3½ inches high, coved top and bottom. Front panel is removable by lifting ½ inch so that wiring is always accessible to meet future needs. Outlets can be provided wherever or whenever needed. It has foot operated switch. Other models with dual hiways for institutions, industrial plants and office building installations are also available. Charles E. Barnes & Son, 4320 Osage Avenue, Philadelphia 4, Pa.

Motor Capacitors

A new line of bracket-mounted, armored, space-saving motor starting capacitors, Series SRVC, has been announced. They are fully-protected against mechanical damage, dirt and usual climatic hazards. The steel casing measures 2-1/16 in. in diameter by 2⅞ in. to 3⅞ in. long depending on voltage and capacitance ratings. Standard ratings are 110, 220, 330, 440 and 660 volts a-c, while capacitances range from 1 to 8.5 mfd. The flexible pigtail leads from the encased capacitor are brought out through the insulated hole in the cap. Aerovox Corporation, New Bedford, Mass.

Fluorescent Unit

The new "Lite-Line 40" continuous line lighting system features "Springlox" safety lamp holders, sliding hangers, channel couplings, and longitudinal shielding for the twin lamp units. It is claimed that it provides 45 to 100 footcandles on work surface. The Springlox construction is claimed to eliminate difficulties in removing or inserting lamps. "Lok-Latch" reflector fasteners hold the porcelain-enameled reflectors to the channel. The system is available in two widths. Benjamin Electric Mfg. Co., Des Plaines, Ill.

Conversion Set

A conversion set to transform unshielded fluorescent fixtures to shielded models is now available. Packed as a complete unit, it allows for flexibility in appearance since the decorative scheme of any commercial space can be altered by substituting either glass panelled or louvered models without dismounting the original unshielded fixtures. The set consists of a shield frame assembly, glass panels or louvers, clips, joint covers and mounting hook or bracket. With this the bare lamp can be converted into a glass shield or louvered model. Sylvania Electric Products, Inc., New York, N. Y.

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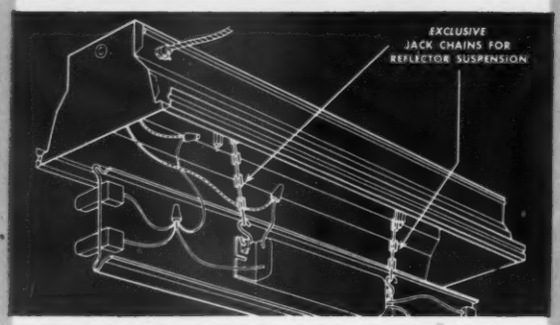
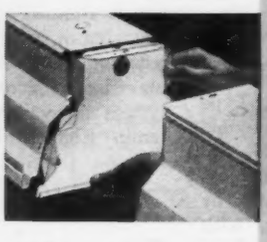
Exclusive Features for Easy Installation & Maintenance



Jack Chain Suspension. For easy wiring access. Two jack chains with "S" hooks suspend reflector from channel. No need to hold reflector or ballast while wiring the unit. Reflector is fastened to channel by simply tightening nuts provided. Saves installation time—simplifies maintenance.



End Plates and Coupling Plates. End plates for use at ends of a continuous row of units. Coupling plates for connecting two units together. All plates have "threaded bushing" holes for simple screw fastening from inside reflector. No nut is needed.

"Swing Hinge" Glass and Louvered Frames. For easy relamping or cleaning. Frames swing down freely on special hinge hooks. Snap shut tightly with two spring latches. Frames are interchangeable—easily removed and replaced in just a few seconds.

Attractive, Economical, Efficient Commercial Troffer Lighting

The new MITCHELL Fluorescent Troffer marks a signal advance in attractive, economical, high intensity lighting for commercial application. Clean-lined, simple—the MITCHELL Troffer offers exclusive advantages for easy installation in any type of ceiling. Available in a choice of three systems: Open type, Glass Shielded, or Louver Shielded. Designed and built to the most exacting standards of quality for maximum effective illumination and minimum service requirements. Acclaimed by wholesalers, contractors, utilities, architects and users as the last word in modern Fluorescent Troffer design!

The new MITCHELL Troffer System features ingenious design of the utmost simplicity and flexibility. It consists of:

1. The "Basic Unit"—(reflector and wireway channel wired with ballast and starters) for 2-40 watt lamps (Model No. 3040); for 3-40 watt lamps (Model No. 3042), and for INSTANT START (Model No. 3041).
2. Hinged Glass Frame—of ribbed, prismatic glass to provide glass shielding (Part No. 323).
3. Hinged Metal Louver Frame—for completely louvered illumination (Part No. 324).
4. End Plate for ends of continuous rows, and Coupling Plate to connect units together in rows.

For ceilings of Tee-Bar snap-in block construction, the "Basic Unit" snaps right into place—requires no accessory fittings. For other types of ceilings—plaster lath, acoustical tile, etc.,—a minimum of simplified fittings are provided to assure easy, accurate, permanent mounting.

MITCHELL

WRITE TODAY for detailed 8-page illustrated Mitchell Troffer Catalog No. 312.

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In Canada: Mitchell Manufacturing Company, Ltd., Toronto, Canada
Far West: *Complete Modern Plant and Sales Office at Los Angeles Serves the Entire Pacific Coast Area*
1019 NORTH MADISON AVENUE, LOS ANGELES 27, CALIFORNIA

Fuse for Transmission Voltages

A new drop-out type fuse, known as "SMD", for application on circuits operating at voltages up to 138 kv. has been announced. It is claimed that this fuse incorporates new features intended to afford "full coverage" protection. The design of the dielectric structure of the fuse tube is coordinated with the dielectric strength of the interrupting bore and with the protected insulation level of the system, preventing flashover, and is of ample mechanical strength to withstand the pressures developed during interruption of large short circuit currents. It is claimed that the dropout feature affords positive, quick release under all conditions of weather or atmosphere. S&C Electric Company, 4435 Ravenswood Avenue, Chicago 40, Ill.

Lamp Ballasts

Designed to meet the lighting industry's need for greater flexibility in planned lighting, two new groups of ballasts for Slimline fluorescent lamps, available in both single lamp and Tulamp high power factor designs and operating at current values of 120 and 300 ma, have been announced. Also new single lamp and Tulamp ballasts for operation of cold cathode lamps have been announced. Of a high power factor design and enclosed in a brick type case, these cold cathode lamp ballasts are designed to operate the 72T8 and the 96T8 lamps at 120 ma. General Electric Company, Schenectady 5, N. Y.

Fluorescent Fixture

A new fluorescent fixture, the Dayliter, is a shallow, louvered unit for two 40 watt lamps. It has been designed to provide more light in work zones. It is claimed that the newly designed louver gives greater cutoff from lamp glare—40° crosswise and 30° lengthwise. It may be mounted individually or continuously; flush to the ceiling, or hung pendant on a special stem set. This fixture is recommended for use in schools, offices, stores and institutions. Smithcraft Lighting Division, Chelsea, Mass.

New Equipment Briefs

An **aluminum step ladder** for industrial or construction job use holds three men, has steps on both sides. Called the Sherry "Life Saver Aluminum Ladder", it is made by J. B. Sebrell Industries of Los Angeles. * * A handy **voltage tester** announced by Ideal Industries, Inc. of Sycamore, Ill., indicates voltage and a-c or d-c by a solenoid indicator and neon test lamp. * * Crystal **lighting fixtures** made in America and claimed to be equal to or better than formerly imported crystal are now in production by Lightolier, Inc. of New York.

Meters for measuring germicidal energy from germicidal lamps are among the new products announced by General Electric Co., Cleveland. They are the **Germicidal Reflectometer,** for measuring energy reflected from walls, the **Germicidal Wattmeter** for measuring the output of the lamp in service and the **Germicidal Ultraviolet Intensity Meter** to measure ultraviolet intensity anywhere in the room in the same way a light meter measures visible illumination.

The Korfund Co., Inc., Long Island City, N. Y., announces a new **conical rubber spring mounting** for motors or machinery with load capacity ranging from 25 to 125 lbs. per unit. * * New heavy duty **booster fans** for use in paint spray booths have been announced by Chelsea Fan and Blower Co., Inc., Irvington, N. J.

A new **electronic amplidyne** consisting of a high-gain balanced d-c electronic amplifier and a motor amplidyne has been announced by General Electric Co., Schenectady, N. Y. * * **Transformers** for machine tool applications have been designed by General Electric Co., Schenectady, N. Y. * * A **voltage regulator** designed to provide controlled voltage for electrically heated aircraft windshields is available from Westinghouse Electric Corp., East Pittsburgh, Pa.

A series of **slimline units** 8 feet long have been added to the line of fluorescent lighting fixtures made by Wm. Penn Fluorescent Light Mfrs., Philadelphia, Pa. * * Electran Manufacturing Company, Tuscola, Ill. has developed air-cooled step-down **transformers** for power circuit installations. * * Langevin Manufacturing Corp., New York City, has announced **photoelectric scanner** Model SC-301 for use on automatic machinery. * * VAP-O-LEC industrial models of electric steam **generators** and electric hot water generators have been introduced by Cronholm Manufacturing Co., Portland, Oregon.

Turbo extruded **plastic tubing,** Type REL-16, is a heat-resistant, improved thermoplastic tubing for protecting conductors. William Brand & Company, New York City. * * A new line of **axial flow pressure fans** has been announced by the Sturtevant Division of the Westinghouse Electric Corp., Hyde Park, Mass. Designed for either vertical or horizontal operation.

International Instruments, Incorporated, New Haven, Conn. announces the production of a specialized line of midget **meters** and allied equipment. * * An adjustable 3-phase **winding head,** Model D, claimed to give faster, easier and more accurate coil winding for 3-phase motors, by Continental Electric Company, Hawthorne, Calif. * * A new type of unlimited travel anti-friction **ball bearing** for linear or reciprocating motion has been developed by Thomson Industries, Inc., Manhasset, N. Y.

"Health-aire" **blowers,** adaptable to ventilating jobs or air conditioning installations by Johnson Fan & Blower Corporation, Chicago. * * A new "quality" line of **solder fluxes** and an "all purpose" cutting compound is announced by Sulflo, Inc. of Elizabeth, N. J. * * **Indicator** for determining phase sequence of polyphase circuits and circuit continuity testing for use by linemen, and industrial plant maintenance crews, is made by H. H. Sell Electric Co., Minneapolis, Minn.

To facilitate tests on electrical installations, a two-way sound powered **telephone system** equipped with test clips at the cord tips, has been announced by the United States Instrument Corporation of Summit, N. J. * * A fluorescent lamp and starter **tester** has been introduced by the Compco Corp., Chicago, Ill. * * A renewable **switch,** Type 101, breaks both sides of the line and is made by Congress Fan and Electric Co., Daytona Beach, Fla.

John T. O'Connor & Company, West Orange, N. J. has developed the **electronic handyman,** photoelectric switch, counter, gauge or control for industrial, commercial or residential use. * * Two postwar models of **Wheatstone bridges** are offered by Industrial Instruments, Inc., Jersey City, N. J. One is a standard portable bridge complete with batteries and case; the other with Murray and Varley loops. * * Westinghouse Electric Corporation, Pittsburgh, has developed **breakers** that permit raising the capacities of self protected distribution transformers.

Photoelectric excess-smoke **indicator,** made by Photoswitch Incorporated, Cambridge, Mass., gives a continuous indication to the boiler room of the condition of the gases which are passing through the flue, signalling when either smoke or air are sufficiently excessive to cause inefficient combustion. * * An electronic repeat cycle **timer** for process control, life testing and laboratory use has been announced by G. C. Wilson & Company, Chatham, N. J. It operates from 115 volts, 60 cycles. * * Joy Manufacturing Company, Pittsburgh has announced a new line of "Axivane" adjutable-blade **fans** for heating, ventilating, and air conditioning in industrial and commercial markets.

Jenn Air Products Company, Indianapolis, Ind. has a new commercial **exhauster,** made of aluminum and designed for mounting on outside wall with its louvered inlet extending through and connecting directly to the duct system. Motor is mounted out of the air stream.

. . . the new Benjamin

LUMINOUS LOUVER CEILING SYSTEM

SKY-GLO is the answer to the Lighting Plan that calls for *Inconspicuous Lighting* with low brightness . . . *More Beauty* with greater seeing comfort! Designed expressly for offices, stores, show windows and other commercial locations, the new Benjamin development features . . .

NEW LUMINOUS VINYLITE LOUVERS

This new system of translucent louvers does more than reflect light . . . it actually glows with light to form a luminous ceiling of unique beauty and atmosphere. This new Benjamin Sky-Glo System is the latest development in "louverall" lighting. With this system it becomes practical to provide . . .

100 TO 125 FOOTCANDLES

of uniform, diffused and comfortable lighting. Crosswise and lengthwise shielding of 45° eliminates glare and uncomfortable brightness. The Sky-Glo System conceals pipes, ducts and fixtures and substitutes at reasonable cost a . . .

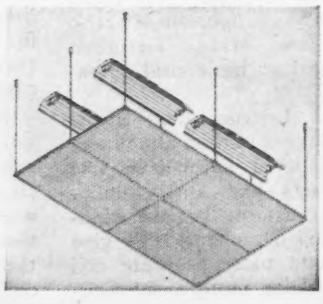
MODERN STREAMLINED CEILING

of low brightness with pleasing architectural and decorative patterns.

Write now for complete Data Bulletin on this new Benjamin development.

BENJAMIN ELECTRIC MFG. CO.
Dept. H, DES PLAINES 12, ILLINOIS

STANDARDIZED STOCK SECTIONS OF LOUVERS, CHANNELS and FITTINGS simplify the layout and installation of the new Benjamin Sky-Glo System. The four sizes of louver sections and the various channel lengths make possible geometric arrangements which provide wide flexibility of design for various ceilings. Louvers are made of Vinylite, a product of The Bakelite Corporation, which has a light transmission factor of approximately 71%. These sections are easily removed for lamp and fixture maintenance and for easy cleaning.



BENJAMIN TRADE MARK
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Distributed Exclusively through Electrical Wholesalers

P-2604 R

New Standards for Integral Horsepower Motors

Five basic motor designs, adopted by the National Electrical Manufacturers Association and effective January 1, 1948, are discussed and analyzed with respect to nameplate identification, application, and significance to the electrical industry.

NEW performance standards for industrial type integral horsepower three-phase squirrel-cage induction motors of 1 to 200 horsepower have been announced by the National Electrical Manufacturers Association. The new performance standards, which became effective January 1, 1948, define five basic types of polyphase induction motors, each of which offers a different combination of torque, speed, and current characteristics to meet the operating requirements of various industrial applications.

These standards are of unusual significance to industrial motor users. They provide a sound basis for selecting the right motor for any industrial application, simplify the specification of minimum acceptable limits of operating performance, and assure interchangeability of motors made by different manufacturers.

Standardization in the electrical motor industry already has resulted in the development of standards relating to preferred horsepower and speed classifications, mounting and frame dimensions, enclosures for various locations and atmospheric conditions, and insulation types and associated limits on ambient temperature, temperature rise, and loading.

The new performance standards apply to five basic types of polyphase squirrel-cage motors, called Design A, B, C, D and F. These characteristics are roughly listed in Table I.

The squirrel-cage induction motor is both reliable and relatively inexpensive but it is not flexible from the standpoint of obtaining a variety of operating characteristics. They are essentially constant speed. To obtain a motor which will materially change its speed with load requires a high-resistance type of rotor using high-resistant materials with small cross section. To obtain various values of locked-rotor torques, many punching configurations and arrangements are resorted to. High locked-rotor currents and breakdown torques are obtained by different stator windings. With a given rotor construction, there is a very close relationship between breakdown torque and locked-rotor current. These methods partially offset the inflexibility of the squirrel-cage motor. Through use and previous unofficial adoption, these characteristics have become established to the points where they can be now classified into basic, standardized designs.

TABLE I

MOTOR CHARACTERISTICS

	TORQUE			
Design	Locked Rotor	Breakdown	Locked Rotor Current	Slip
A	normal	high	high	less than 5%*
B	normal	high	low	less than 5%*
C	high	normal	low	less than 5%
D	high	low	low	5% or more
F	low	low	low	less than 5%

* Motors with 10 and more poles may have slip slightly greater than 5%.

The characteristics of the five types of integral motors are roughly listed for reference purposes. More exact data are tabulated and presented graphically in accompanying Tables and Charts.

LOCKED-ROTOR CURRENT

Squirrel-cage induction motors have an inherent characteristic of drawing large inrush currents on starting. This may cause blinking of lights on a system of small capacity or where currents are excessive. Locked-rotor current is not identical with starting current, but it indicates the current that will be drawn from the line in starting, and so it is of interest to the customer. The Standards state that all five types of induction motors are designed to withstand full voltage starting directly across the power lines. This means that the motors are mechanically strong enough to withstand the magnetic stresses and the high locked-rotor torques developed at the time the switch is closed. However, in the case of Design A motors, the locked-rotor currents are such that motors should be started with reduced voltage. Locked-rotor currents for Designs B, C and D motors drop from a value of about 24 amps. per hp. at 1 hp. down to a value of 14 amps. per hp. at 10 hp. Locked-rotor currents for Design F motors are approximately 9 amps. per hp.

The locked-rotor current of three-phase, 60-cycle, constant-speed induction motors, measured with rated voltage and frequency impressed and with rotor locked, are designed to fall below the values presented in tabular form in

TABLE II

LOCKED-ROTOR CURRENT OF THREE-PHASE, 60-CYCLE MOTORS AT 220 VOLTS*

HP	Design B, C, and D, Amperes	Design F, Amperes
1 or less	24 amps. per hp.	....
1½	35	....
2	45	....
3	60	....
5	90	....
7½	120	....
10	150	....
15	220	....
20	290	....
25	365	....
30	435	270
40	580	360
50	725	450
60	870	540
75	1085	675
100	1450	900
125	1815	1125
150	2170	1350
200	2900	1800

*Locked-rotor current at other voltages shall be inversely proportional to the voltage.

The locked-rotor current of three-phase, 60-cycle, constant-speed, induction motors, measured with rated voltage and frequency impressed and with rotor locked, shall not exceed the values listed in the Table above.

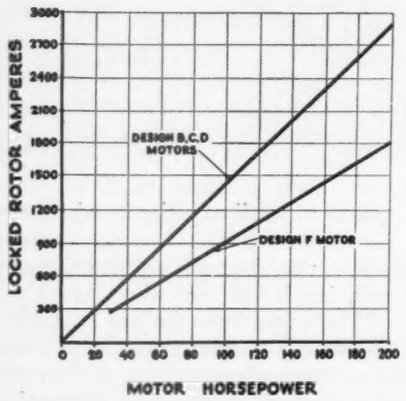

CHART A

Locked-rotor currents for Designs B, C and D drop from a value of about 24 amps. per hp. at 1 hp. down to a value of 14 amps. per hp. at 10 hp. The locked-rotor currents for Design F motors are approximately 9 amps.

Table II and shown graphically in Chart A.

BREAKDOWN TORQUE

Breakdown torque is the maximum torque that a motor can deliver without abrupt decrease of speed. It can ordinarily be considered as the maximum torque which the motor is capable of delivering. It is usually expressed as the percentage of the torque the motor would deliver when operating at rated speed and horsepower. In other words, the percentage breakdown torque gives a direct indication of how much overload can be momentarily placed on a motor. Maintained voltage and frequency is, of course, assumed, as all torques of an induction motor vary directly as the square of the voltage changes. The values of breakdown torques specified in the Standards represent the upper limit of the range of application for the various classes of motors. If an application requires a breakdown torque higher than that shown for any given rating, it is recommended that the next larger rating be selected. It is usually good practice to apply motors at momentary loads at least 20 percent below the maximum torque ranges shown in order to offset that much torque drop due to an allowable 10 percent voltage drop. No breakdown torque values are given for the Design D motor, since such motors have no sharply defined breakdown torque. It is again emphasized that there is a close relationship between breakdown torques and locked-rotor currents. Design A motors have exceptionally high breakdown torques but at the expense of exceptionally high locked-rotor currents. On the other hand, Design F motors have exceptionally low locked-rotor currents but also have exceptionally low breakdown torques. Table III lists breakdown torques of polyphase squirrel-cage motors with continuous ratings. Chart B presents the breakdown torques of 1800 rpm. motors in graphical form.

TABLE III

BREAKDOWN TORQUE OF POLYPHASE SQUIRREL-CAGE MOTORS WITH CONTINUOUS RATINGS

HP AND SYN. SPEED-RPM (60 and 50 cycles)	BREAKDOWN TORQUE (Per Cent of Full-load Torque) Design A	Design B	Design C
½ — 900- 750	IN EXCESS OF VALUES SHOWN FOR DESIGN B	250	...
Lower than 750		200	...
¾ —1200-1000		275	...
900- 750		250	...
Lower than 750		200	...
1 —1800-1500		300	...
1200-1000		275	...
900- 750		250	...
Lower than 750		200	...
1½ —3600-3000		300	...
1800-1500		300	...
1200-1000		275	...
900- 750		250	...
Lower than 750		200	...
		275	...
2 —3600-3000		275	...
1800-1500		275	...
1200-1000		250	...
900- 750		225	...
Lower than 750		200	...
3 —3600-3000		250	...
1800-1500		275	...
1200-1000		250	225
900- 750		225	200
Lower than 750		200	...
5 —3600-3000		225	...
1800-1500		225	200
1200-1000		225	200
900- 750		225	200
Lower than 750		200	...
7½ —3600-3000		215	...
1800-1500		215	190
1200-1000		215	190
900- 750		215	190
Lower than 750		200	...
10 HP—3600-3000		200	...
1800-1500		200	190
1200-1000		200	190
900- 750		200	190
Lower than 750		200	...
15 HP—to 25 HP, all speeds		200	190
30 HP—and larger, all speeds		200	190

The breakdown torque of Design A, B and C, 60 and 50 cycles, polyphase squirrel-cage motors, with rated voltage and frequency applied, shall be in accordance with the values listed above, expressed in percent of full-load torque and representing the upper limit of the range of application for these motors. The torque for Design F motors, 30 hp. and larger, all speeds is 135 percent.

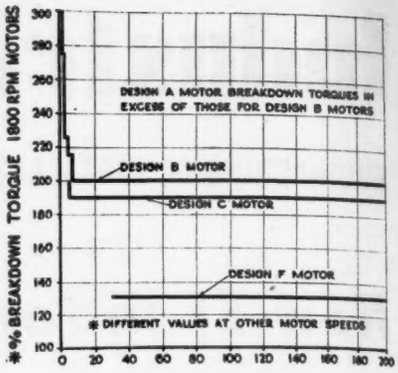
% BREAKDOWN TORQUE 1800 RPM MOTORS
DESIGN A MOTOR BREAKDOWN TORQUES IN EXCESS OF THOSE FOR DESIGN B MOTORS
DESIGN B MOTOR
DESIGN C MOTOR
DESIGN F MOTOR
* DIFFERENT VALUES AT OTHER MOTOR SPEEDS
MOTOR HORSEPOWER

CHART B

Design A motors have exceptionally high breakdown torques but at the expense of exceptionally high locked-rotor currents. On the other hand, Design F motors have exceptionally low locked-rotor currents but also have exceptionally low breakdown torques. No breakdown torque values are given for the Design D motor, since such motors have no sharply defined breakdown torque.

LOCKED-ROTOR TORQUE

Locked-rotor torque is the torque developed by the motor while at a standstill. It is also called the starting torque. It is usually expressed in percentage of full-load torque. Locked-rotor torques for the various designs of motors are established by these recently approved Standards and, as in the case of breakdown torques, these represent the upper limits of application for the various designs of motors. Design F motors have the least locked-rotor torque, A and B next, then C with D the highest. Higher locked-rotor torques for the smaller hp. motors can be rather easily obtained, since higher locked-rotor currents are permissible. It is, therefore, possible to have Design B motors perform on applications for both Design B and C motors in lower hp. ranges, and the

TABLE IV

LOCKED-ROTOR TORQUE

HP		DESIGNS A AND B								DESIGN C		
		Synchronous Speeds								Synchronous Speeds		
	60 cy.	3600	1800	1200	900	720	600	514	450	1800	1200	900
	50 cy.	3000	1500	1000	750	600	500	428	375	1500	1000	750
½		...	...	...	150	150	115	110	105	...	...	...
¾		...	...	175	150	150	115	110	105	...	...	...
1		...	275	175	150	150	115	110	105	...	...	...
1½		175	265	175	150	150	115	110	105	...	...	...
2		175	250	175	150	145	115	110	105	...	...	...
3		175	250	175	150	135	115	110	105	...	250	225
5		150	185	160	130	130	115	110	105	250	250	225
7½		150	175	150	125	120	115	110	105	250	225	200
10		150	175	150	125	120	115	110	105	250	225	200
15		150	165	140	125	120	115	110	105	225	200	200
20		150	150	135	125	120	115	110	105	200	200	200
25		150	150	135	125	120	115	110	105	200	200	200
30		150	150	135	125	120	115	110	105	...	...	...
40		135	150	135	125	120	115	110	105	...	...	...
50		125	150	135	125	120	115	110	105	...	...	...
60		125	150	135	125	120	115	110	105	...	...	...
75		110	150	135	125	120	115	110	105	...	...	...
100		110	125	125	125	120	115	110	105	...	...	...
125		100	110	125	125	120	115	110	105	...	...	...
150		100	110	125	125	120	115	110	105	...	...	...
200		100	100	125	125	120	115	110	105	...	...	...

The locked-rotor torques of A, B and C, 60 and 50 cycle, polyphase squirrel-cage motors, with rated voltage and frequency applied, shall be in accordance with the values above which are expressed in percentage of full-load torque and represent the upper limit of the range of application for these motors.

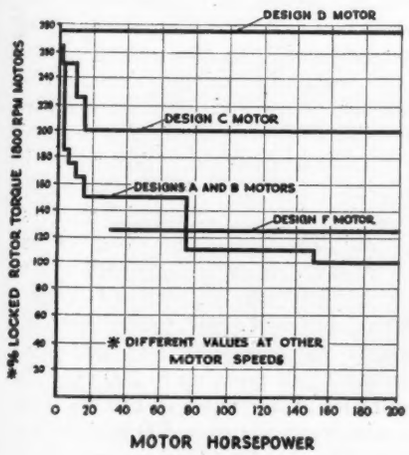
DESIGN D MOTOR
DESIGN C MOTOR
DESIGNS A AND B MOTORS
DESIGN F MOTOR
* DIFFERENT VALUES AT OTHER MOTOR SPEEDS
*% LOCKED ROTOR TORQUE 1800 RPM MOTORS
0 20 40 60 80 100 120 140 160 180 200
MOTOR HORSEPOWER

CHART C

Design F motors have the least locked-rotor torque, A and B next, C next and D the highest. These values represent upper limits of application for the various designs of motors.

Design C motor need not be standardized below 3 horsepower.

Locked-rotor torques of Design A, B and C are tabulated in Table IV. Values for all five designs are graphically presented in Chart C.

The locked-rotor torque of Design D, 50 and 60 cycle, 4, 6 and 8 pole polyphase squirrel-cage motors, with rated voltage and frequency applied, shall be 275 percent, expressed in percentage of full-load torque, and represents the upper limit of application.

The locked-rotor torque of Design F, rated 30 hp. and larger, shall be 125 percent under the same conditions and expressed in the same units. This is the upper limit of application for these motors.

MOTOR SLIP

If an induction motor is operating at no load and then rated load is applied, its speed will decrease. This change of speed is known as its slip at full load, and is usually expressed in the percent of no load (or synchronous) speed. In most applications, a constant speed (low slip) is desired. Motors of Design A, B, C and F are defined as having slip at rated load of less than 5 percent, with the exception that motors having 10 and more poles (very low speed) may slightly exceed 5 percent. Slip is diagrammed in Chart D.

NAMEPLATE IDENTIFICATION

A typical nameplate for a squirrel-cage induction motor includes the information necessary for applying, replacing or repairing a given motor. The new Standards recommend that the design letter be stamped on the nameplate. All motors of a given design letter should be interchangeable from an operating standpoint. In addition, most nameplates will undoubtedly show a code letter which gives specific information as to the locked rotor current characteristic. With the new

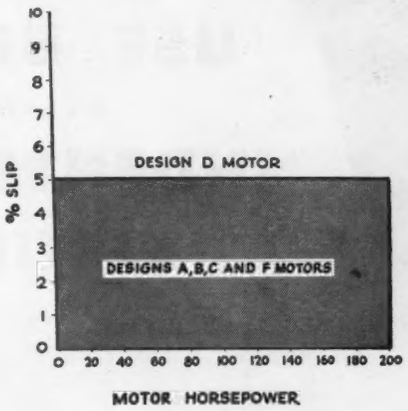

CHART D

Motors of Designs A, B, C and F are defined as having slip at rated load of less than 5 percent, with the exception that motors having 10 and more poles (very low speed) may slightly exceed 5 percent.

Standards, there will be a direct relationship between the design letter and the code letter. It is felt that with these Standards, motors of the usual types will be defined so that a buyer or specifying engineer will know what performance can be expected. Although details of different manufacturers may vary, all motors will be readily identified by the design letter on the nameplate.

APPLICATION

Different motor-drive applications encountered in the field call for selecting motors in accordance with performance demands. As an example, consider a light-duty belt conveyor. Static friction and inertia have little effect of the application of a motor for such a conveyor. Either Design A or B could be selected. If need exists for a minimum locked-rotor current, Design B would be selected.

Design B motors are used for driving machine tools, blowers, fans, centrifugal pumps, packaging machinery, most textile machines, where slightly more than full-load torque for starting is sufficient and high speed (i.e., low slip) and high breakdown torques are needed.

A different conveyor problem is created where loads being conveyed are heavy and the demand on the motor on starting is severe. A Design A motor would not have sufficient locked-rotor torque to start the conveyor. A Design C motor would be used because of its inherent locked-rotor characteristic. Design C motors are used for plunger pumps, compressors which are not unloaded on starting, oven chain conveyors affected adversely by temperature conditions, and machines needing high locked-rotor torque with low locked-rotor current, but normally

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running at rated full load and not liable to high overload demands after they are up to speed.

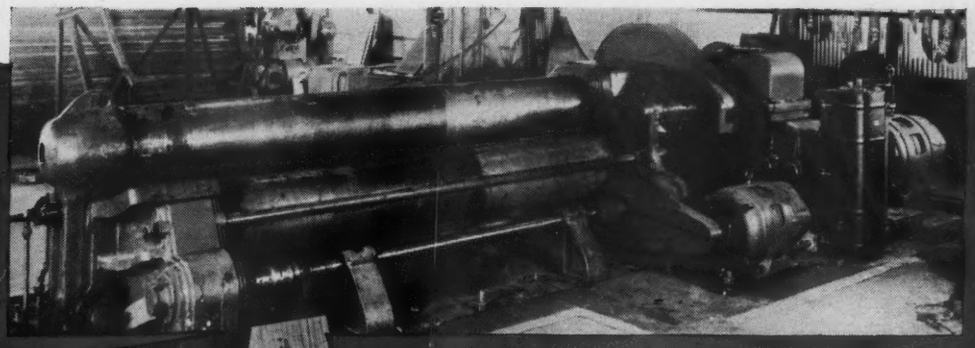
The Design D motor is a motor which develops high locked-rotor torque and will ease off in speed instead of maintaining speeds close to synchronous speed when surge loads are encountered. It also develops high torque to recover speed rapidly. Design D motors are applied to hoists, to machines with large flywheels such as conventional punch presses, and to machines where heavy loads are suddenly applied and removed at frequent intervals.

The fifth type of motor, Design F, has a very limited field of application since it develops only very low-breakdown torque. It is purposely so designed for securing a very low locked-rotor current condition. A planer cutter drive on a woodworking machine, where little effort is required to start and accelerate the light cutter blade, and where a machine is likely to be installed where the generating or distributing system is adversely affected by line current variations are typical load examples for which Design F motors are well suited but seldom encountered.

Each motor manufacturer is free to build motors to NEMA standards or not, as he sees fit. Experience indicates, however, that the advantages of standardization to the purchaser and user result in volume demand for standard items and most manufacturers will be eager to supply this demand.

Standardization will also result in increased production. This is vitally essential. Despite substantial progress in whittling down backed-up orders for motors, manufacturers still face a record log-jam of unfilled orders which, on July 1, 1947, totaled approximately 23 million motors and generators of all types up to 200 hp. The estimated dollar value of this back-log is conservatively over 500 million dollars. These orders continue to pour in to the manufacturers due to the wider motorization of machinery in manufacturing industries, a broadening use of motor drives on machine tools, a growing dependence upon motor-driven household appliances, and a continued growth in rural electrification.

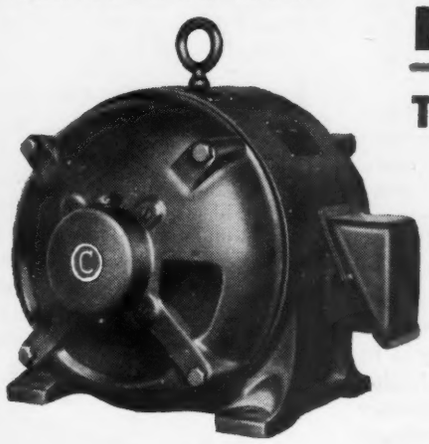
This article is a condensation of data compiled by the N.E.M.A. Motor and Generator Section, and reports prepared by E. E. Helm, Reliance Electric and Engineering Company, Chairman of the Section; C. P. Potter, Wagner Electric Corporation, Retired Chairman; M. S. Hancock, Westinghouse Electric Corporation, Vice Chairman, General Engineering Committee; and F. J. Geiger, Allis-Chalmers, Vice Chairman, Integral Horsepower Subsection.

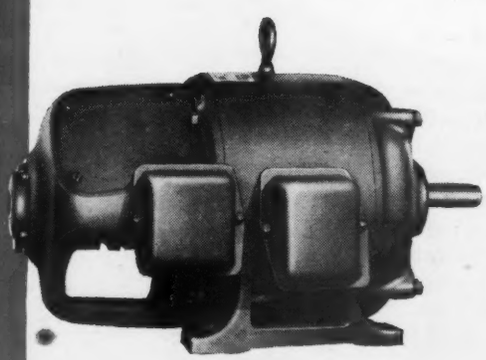


Supply Variable Speeds — Century 75 and 30 horsepower Slip Ring motors permit a range of speeds and reversing direction of rotation—to meet changing load requirements of this bending roll.

Provides Smooth Continuous Power — Century 2 horsepower SC motor supplies power for this steel cutoff saw.

Cushions High Impact Loads — Century 40 horsepower SCT motor slows down, cushions the impact of shearing or forming.





Select the

Right CENTURY MOTOR

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Reader's Quiz

Relay Control

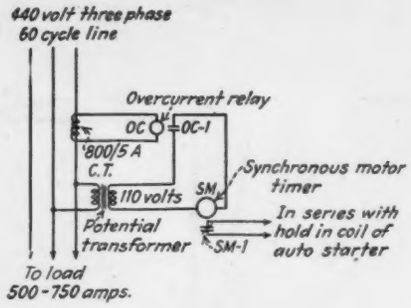
QUESTION 264—I want to connect a current transformer in one leg of a three phase 440 volt line, to control a relay which in turn will open the holding circuit of a large auto starter when the demand peak of the three phase line reaches a range of 500-750 amperes steady pull for at least one minute or longer than the usual duration of high starting currents. Can you give me a formula on the current transformer? What type of relay shall I use? The relay must not operate on the high starting currents, and must have a rheostat or tapped transformer in its holding circuit so as to give variable control. My idea is to establish a certain load peak as our electric bill is partly based on the demand charge.—D.A.

A. TO QUESTION 264—Assuming that D. A. is talking about balanced three phase loads and that he wishes to detect kva. demand maximums rather than kw. demand maximums, I would suggest the use of an 800/5A current transformer of any standard type, a small potential transformer, a General Electric PAC overcurrent relay, and a small Cramer synchronous motor timer relay wired as per the sketch.

The PAC overcurrent relay should have a 5 amp. coil with a set of normally-opened contacts. This relay is simple to adjust for two factors.

1. A height of plunger adjustment to correspond to changes in overcurrent settings desired as indicated by D. A.
2. An inverse time delay adjustment operating on an air-orifice system designed to hold relay in during current surges such as is obtained on motor starting. This feature prevents unnecessary operation of the synchronous motor timer relay.

The synchronous motor timer relay should have a 115 volt 60 cycle motor and a set of normally closed contacts. The timer can be adjusted for opening contacts in one or two minutes. When de-energized it is automatically reset.



Circuit operation is as follows:

1. On any motor starting current of reasonable duration the PAC relay air-orifice adjustment prevents operation.
2. On any sustained current demand beyond setting of the PAC relay the PAC relay contacts will close and the Cramer synchronous motor timer starts timing.
3. When the synchronous motor timer has timed out whatever time the operator wishes the contacts open and de-energize the holding coil of the auto starter.
4. If the sustained current demand should decrease before the synchronous motor timer has timed out, the contacts of the PAC relay will open and the synchronous motor timer will automatically reset itself.

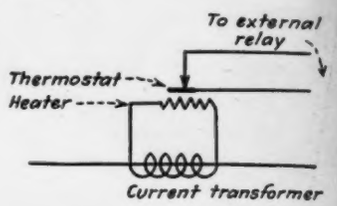
The current transformer is selected with a ratio of 800 to 5 to correspond with the maximum current likely to be met of 750 amps. In this application volt-ampere burden, transformer power factor, and transformer voltage rating are not important.—M.D.P.

A. TO QUESTION 264 — A small size automatic reset bimetallic magnetic motor starting switch, adjusted so that the heater will bridge one leg about 100 ft. long, or the secondary of a current transformer will provide the results you want. The heaters start at .7 amps., and are used to protect motors. A rheostat across the heater terminals will allow current adjustment over any range you want. The parts are available in many supply houses.

CAUTION: The disconnected load should be connected ahead of the heater.—H.S.

A. TO QUESTION 264—With reference to the question by D.A., a circuit that will do the job simply is a transformer in conjunction with a resistive load and a thermostat. By proper choice of thermostat and resistor, any type of time delay action can be obtained. By either tapping the resistor or the auto transformer the thermostat can be arranged to act as desired.

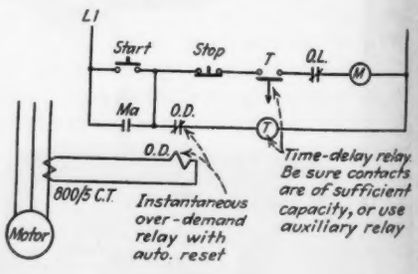
The unit has another advantage in that the time lag may be made similar

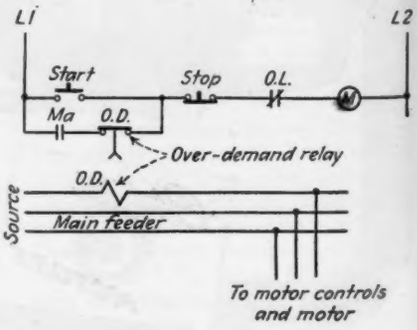


to that in a maximum demand meter in which case its operation will parallel that of the meter.

The unit may be calibrated readily by the use of an external current source. As a start, I would suggest a 5 ohm 5 watt tapped resistor and a thermostat to cut in at 200°F.—H.H.S.

A. TO QUESTION 264—There are several methods of controlling your maximum demand. Assuming your large motor may be shut down with no great inconvenience, I would use a standard over-load relay, with the current coil in one leg of the *main feeder*, and the secondary normally-closed contacts in the holding circuit of your starter. In this way, the motor will be shut down only if the over-all





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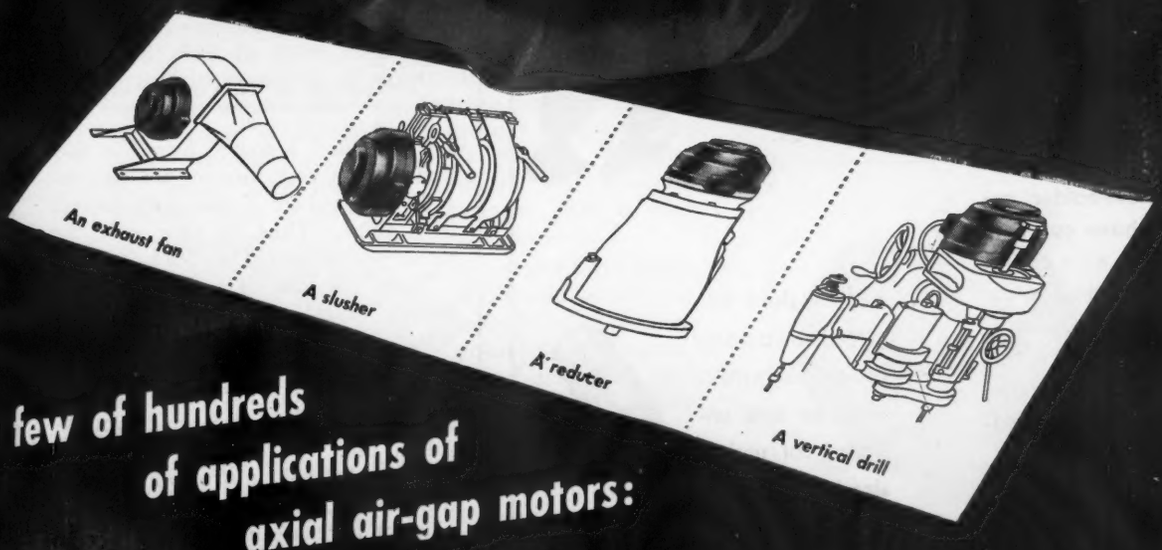

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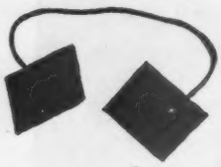

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plant demand exceeds your predetermined limit. Inexpensive magnetic overload relays, with a range of 400 to 1700 amps. are available, with dashpot to control the desired time delay. Such a relay would have the advantage of an inverse time characteristic, i.e., it would trip faster on a heavy over-demand than on an over-demand of moderate proportions. This could be readily adjusted to suit your conditions, and the relay will not operate on normal motor starts.

If you wish to use a current transformer, and a definite time delay, use a current transformer whose rating is somewhat higher than your maximum load. The secondary of a current transformer is rated 5 amps., so if you wish to use the transformer in your motor feeder, use an 800/5 amp. current transformer. Thus, at 700 amps., you will have $\frac{700}{800} \times 5 = 4.375$ amps in the secondary leads. In connection with this, use a standard over-load relay of the instantaneous type with automatic reset, (which may readily be adjusted for whatever value you wish it to trip) and connect as illustrated. The time delay relay may be adjusted to open at whatever time delay you find it desirable to use—from a few seconds to several minutes.

—W.E.T.

A. TO QUESTION 264—The following might be the formula you seek for the application of current transformers:

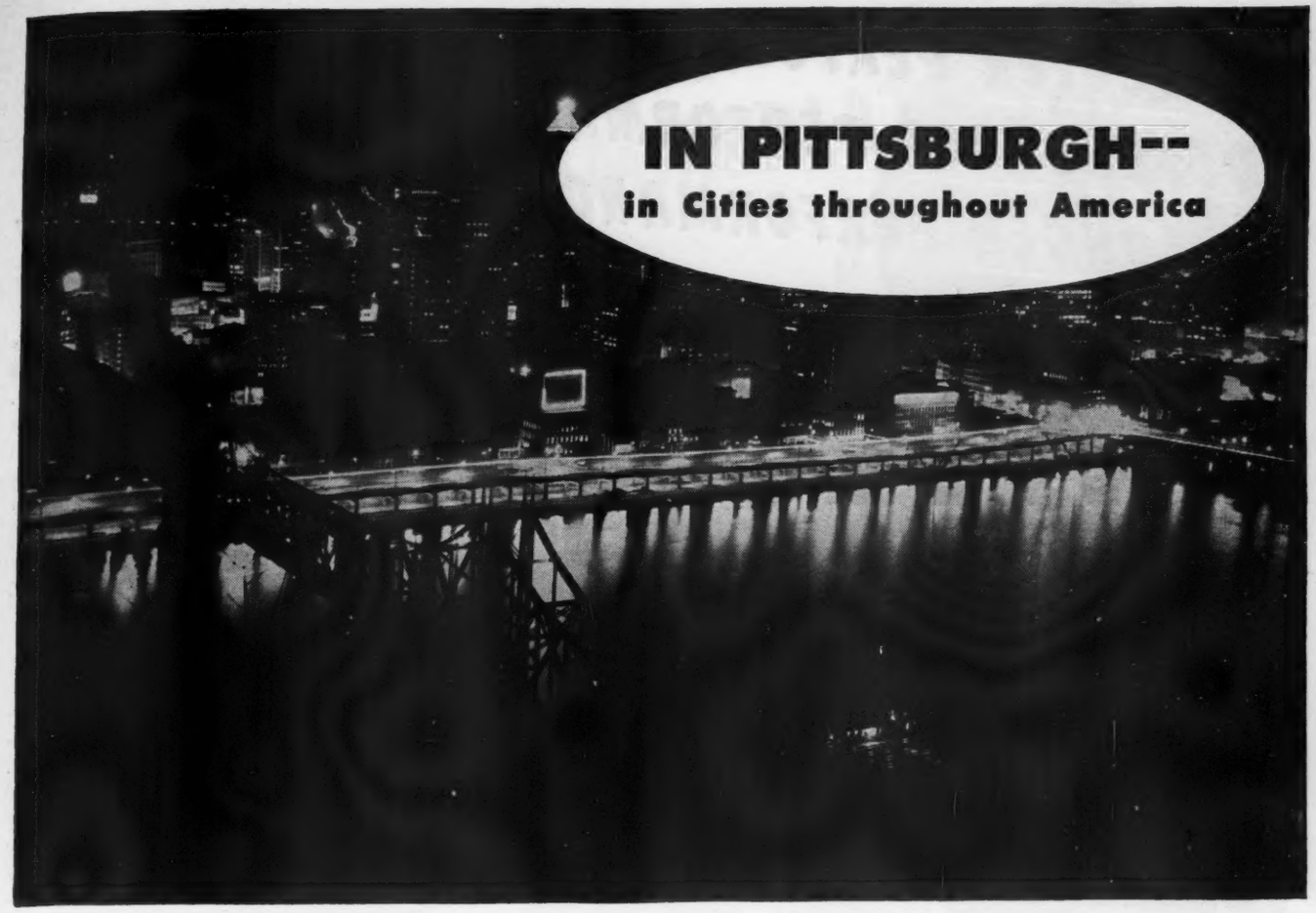
$$\text{Ratio} = \frac{\text{Total amps. of main bus or cable}}{5}$$

The factor 5 comes from the fact that current transformers are customarily designed for a secondary current of 5 amps. Thus, in your case, the ratio required would be 750/5 or 150/1.

Since the cost of a 1000/1 transformer would be little more there would be an advantage of a lower operating secondary current which would reduce the expense of a rheostat if that is the control which you decide to use.

As additional information on the transformer, you will also need to provide for purchase information the outside diameter of the cable (or cables), or bus, since these are actually the primary of the transformer, and must pass through the secondary coil. To reduce installation cost it might be advantageous to consider the split core type transformer which could be applied without disturbing the present bus or cable installation.

An alternate to the tapped transformer, or rheostat, for adjustment purposes would be to use a thermal



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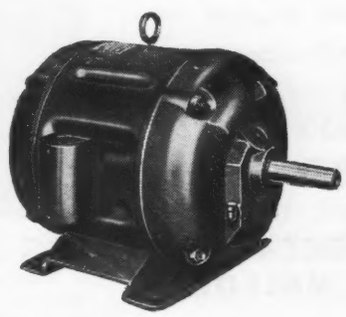

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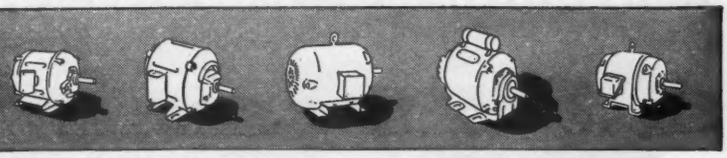

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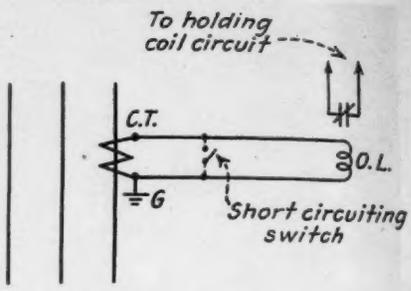

overload relay, the coil of which is connected into the secondary of the transformer. (See sketch above). These relays are of the type used on many types of motor controllers and any adjustment necessary could be obtained by changing heater elements which are simple to change. Once the right combination has been established there is nothing subject to mal-adjustment. The usual caution should be exercised by short circuiting the transformer secondary when exchanging coils on the relay.

Since the rating of coil or heater element selected will depend on the secondary amps. determined upon, you will need to get this information from the manufacturer of the relay used. Say you want to cut off the power to the starter when you have a sustained bus load of 750 amps. With a 150/1 transformer the secondary amps. would be 5 and you would have the manufacturer supply the relay with a heater coil which would trip the relay in the selected time with 5 amps. passing through the heater coil.—K.E.L.

Auto Transformer

QUESTION 265—Four 10 kw. heating units are connected in series across a 440 volt a-c single phase circuit. A balancing coil, consisting of a tapped winding with a magnetic core, is connected in parallel to prevent high arcing in the event of a burnout, and to keep the other units in operation. In the event of a burnout, how does the current divide and how much current passes through the winding that bridges the break? Does the transformer action of this part of the balancing coil deliver any current to the circuit? How about when two or three units burn out?—C.R.

A. TO QUESTION 265—The balancing coil is an auto-transformer connected across the 440 volt a-c circuit. The four 10 kw. heaters in circuit (Fig. 1) will draw 91

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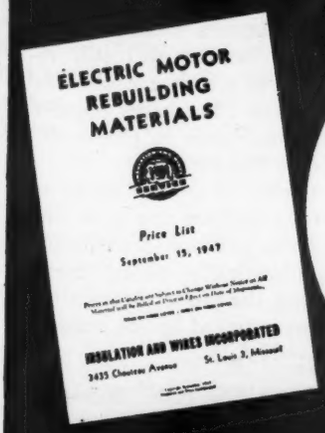

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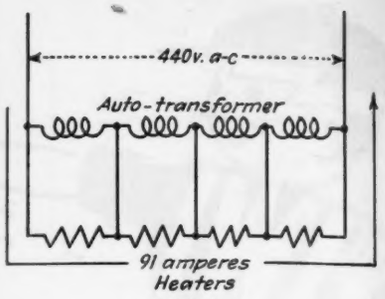


FIG.1

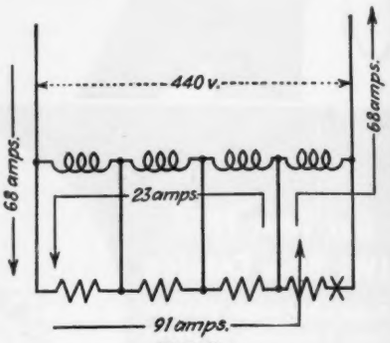


FIG.2

amperes from the line and the auto-transformer will draw a small exciting current besides.

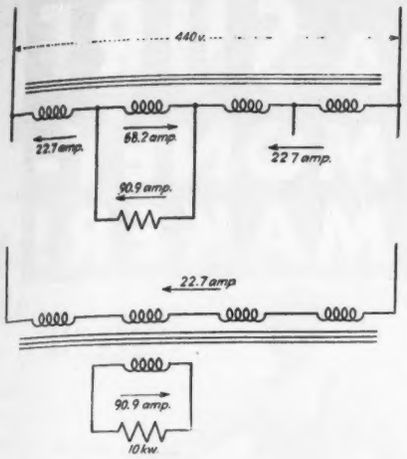
Assume an open circuit in one heater at the point X (Fig. 2). The heater load is then reduced to 30 kw., which will draw 68 amperes from the line. The remaining heaters will still require 91 amperes which are obtained by the addition of 23 amperes supplied by the auto-transformer in phase with the 68 amperes line current.

The same principle applies when two or three of the heaters are open circuited. The line and auto-transformer currents automatically adjust themselves to supply the proper proportions of the current required by the remaining heaters.—H.A.W.

A. TO QUESTION 265—For illustration, the balancer coil will be assumed to have 100% efficiency when operating as an auto-transformer. Also, the calculations will not be refined to include the magnetizing components of the transformer current.

Fig. 1 shows a conventional 4 to 1 transformer supplying one heater. The current in the primary winding is equal to 10 kw. divided by 440 volts, or 22.7 amp. The current in the secondary winding is 10 kw. divided by 110 volts, or 90.9 amp. The secondary current in any transformer ALWAYS takes a direction which will oppose the primary current.

If the secondary winding in Fig. 1 is superimposed on a segment of the primary winding, the result will be an auto-transformer shown in Fig. 2. It will be noted that the same current is drawn from the line as in Fig. 1. Also,



the same current flows in the heater and in the same direction. The current in the one section of the balancer is now, however, the DIFFERENCE between the heater current and the line current, and takes a direction opposite to the line current.

To generalize this problem, the current which "passes through the winding that bridges the break" is equal to and in the same direction as the line current. The line current is equal to the remaining connected heater load, divided by the line voltage. The current in any heater equals the heater wattage divided by the heater voltage, and flows in the same direction as the line current. The current in any coil section connected to a "working" heater is the difference between the heater current and the line current, and flows opposite to the line current. This generalization holds, regardless of the number of heaters which have burned out, or their positions on the balancer coil.—L.E.B.

A. TO QUESTION 265—When the four 10 kw. heating units connected in series and tapped by the balance coil are operating normally, only a magnetizing current flows through the balance coil. Should one of the heating units burn out, then the balance coil across this unit must take the entire current from the other heating units. This current must act as magnetizing current and also feeds energy into the balance coil which in turn will tend to raise the voltage on the other units and lower the voltage across the burned out unit. A properly designed balance coil will not increase the voltage across the heating units to a dangerous value even though as many as three windings may burn out. There will be an auto transformer action in the balance coil and the units should continue to operate entirely satisfactorily. The exact division of current between the balance coils and the heater units is determined by the design of the balance coil.

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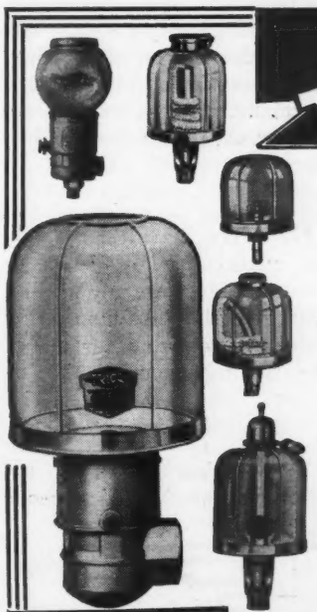

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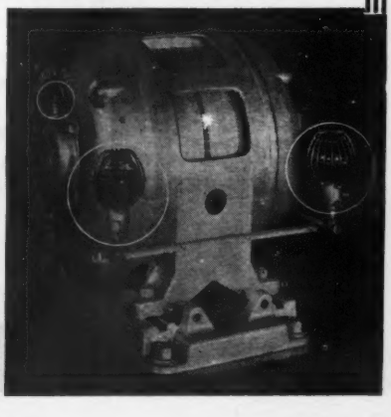

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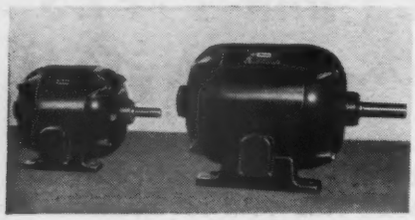

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New 5 h.p. totally enclosed, non-ventilated Westinghouse motor (at left) protected with Silicone Insulation has same rating as much larger motor (at right) wound with Class A insulation.

This is the kind of industrial news we like to report. It's the story of that new Silicone insulated, totally enclosed, non-ventilated motor made by Westinghouse. This motor weighs only 60% as much as a comparable motor of conventional design. It requires no more space than an open motor of the same rating, and it is comparable in overall performance.

This very significant reduction in size and weight is a result of skillful designing to capitalize upon the exceptional heat stability of the silicone resins and varnishes developed by Dow Corning. These silicone varnishes are not affected by the somewhat higher operating temperatures which are caused by the relatively small radiating surface. The hottest spot temperature rise of this motor is within the 140°C. permissible for this new class of electrical insulation.

This new motor also incorporates another example of progressive engineering in the use of new materials. Its bearings are permanently lubricated with DC 44 Silicone Grease. Consequently, they require no attention for at least five years, in spite of the somewhat higher temperatures at which they operate.

The introduction of this new Silicone insulated motor marks a new era in electrical insulation. The use of Silicone Grease in the bearings marks another major step in the direction of permanent lubrication.

Silicones have been responsible for all sorts of improvements in design and performance, ever since we started to produce them on a commercial scale nearly five years ago. Our experience in putting these new engineering materials to work is at your service. We'll be glad to send you our catalog K 1-6 which describes DC Silicone resins, greases, fluids and Silastic.*

*TRADEMARK FOR DOW CORNING SILICONE RUBBER

DOW CORNING CORPORATION
MIDLAND, MICHIGAN
New York • Chicago • Cleveland • Los Angeles
In Canada: Fiberglas Canada, Ltd., Toronto
In England: Albright and Wilson, Ltd., London

Dow Corning
FIRST IN SILICONES

Perhaps you can visualize what happens better by considering the balance coil as an auto transformer. As you probably know, the voltage across the load coil of an auto transformer changes very little from full load to no load in the transformer.—L.R.B.

A. TO QUESTION 265 — This setup is equivalent to an auto transformer with tops and with no openings in the heating units we would have a ratio of 1 to 1. Now if one of the end units open (the end one being select for clarity) what you would have is an auto transformer with step down ratio of 4:3 and full load current in primary of 30 kw. divided by 440 volts, and the secondary carrying a 3 kw. load at 330 volts.

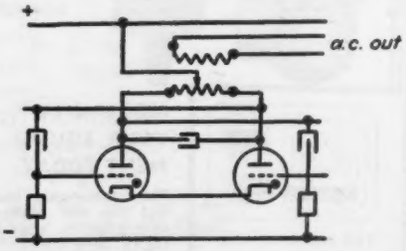
In the event three units burn out, one can easily see here an auto transformer of ratio 4:1 with the primary carrying 10 kw. at 440 volts and the secondary 10 kw. at 110 volts.—E.J.K.

Can you ANSWER these QUESTIONS?

QUESTION N12 —The plant where I am employed has a number of spot welders. I would like to know why the cables to the welding guns separate outward from each other noticeably when the guns are fired to weld? Yet when these cables are taped together this is not so noticeable. The welders operate normally. Is it a mechanical or electrical reason that causes this?—L.C.D.

QUESTION P12 —We have some kilowatt-hour meters that we desire to test for accuracy. Is there any method without a large outlay of equipment or time, maximum two hours per meter, that can be used to accomplish this?—L.R.D.

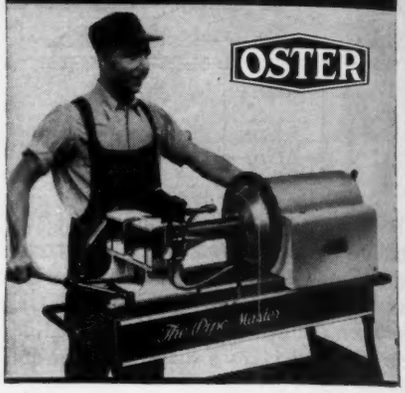
QUESTION Q12 —Below is a thyratron inverter diagram. Could someone



explain how it is started and the a-c frequency is controlled?—E.J.K.

PLEASE SEND IN YOUR ANSWER BY FEBRUARY 15

A SURE MONEY-MAKER!



"Pipe Master"
THREADING MACHINE

Speedy before . . . now speedier than ever with the new "SPIN-FAST" Wrenchless Chuck. A quick spin of the easy-grip wheel, chucks and unchucks instantly for any size pipe within range of machine.

With the "PIPE MASTER", you can thread pipe from two to five times faster than the muscle-straining hand method. Thread, cut, ream pipe and bolts the EASY way . . . the "PIPE MASTER" way!

Standard range: 1/4" to 2" pipe. Extra range 1/8" pipe. Range with auxiliary drive shaft: 2 1/2" to 6" pipe. Bolt range: 1/4" to 1 1/2".

Nipples as short as 3 1/2" in the 2" size can be threaded on both ends (as illustrated) *without using a nipple chuck!* (Other sizes in proportion). Pipe or studs as short as 2 1/2" can be held and threaded on one end.

Ask for Catalog No. 24-A

THE OSTER MFG. COMPANY
2081 E. 61st St. • Cleveland 3, Ohio • U.S.A.

OSTER

Motor Shops

Compact Motor Bearing Department

Everything in its place and within easy reach of the mechanic was one of the basic design principles in the small motor repair department of the Koontz-Wagner Electric Company, South Bend, Indiana. Typical of the many space and time-saving features of the layout is the bearing department.

Total area required is that occupied by a small workbench and stock cabinet mounted back-to-back. On the bench top are a machinist's vise, small arbor press and drill press (see photo). Mounted to a backboard are long steel pins (at about a 60-degree angle) on which an adequate supply of the more commonly used bearings is kept; also racks for various types of drills and reamers. On the other side of the backboard is a cabinet in and on which a complete stock of bearings is stored.

The bearing department is in a U-shaped area formed by the disassembly and assembly benches, only a few steps on either side. A short distance in front of the bearing bench is a small lathe and grinder. This layout permits concentration on mechanical repairs while the electrical components are being handled in another department. No waste steps are required to secure parts or equipment.

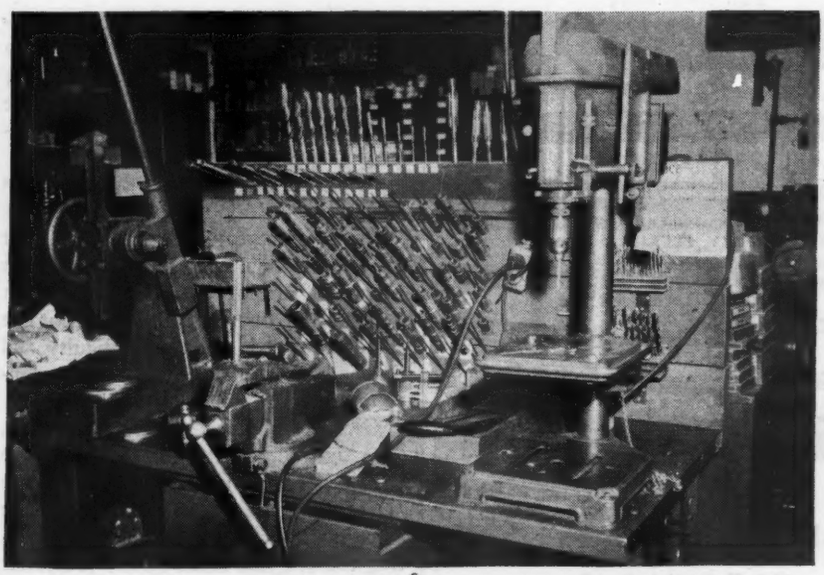
Coils Wound By Lathe

A lathe, installed in the shop of the Mo-Gen Electric Company, Stamford, Connecticut, serves a dual purpose since it is used as an auxiliary coil winder. Both the installation of the lathe and its application as a winder are unique.

Although the lathe was designed to operate from an overhead belt drive, the light construction of the shop ceiling made such an installation impractical. A "floating ceiling", consisting of a sturdy plank frame, was constructed to carry the required motor and pulleys and was hinged to the lathe base. The frame extends upwards at the rear of the lathe and leans slightly outward from the base. A turnbuckle, cushioned in rubber grommets, connects the upper section of the frame to the lathe bed plate. Adjusting the turnbuckle regulates the inclination of the frame away from the lathe and also controls the tension on the driving belt. The rubber cushioning isolates vibrations.

When used as a coil winder, a steel shaft is inserted through the headstock of the lathe and rigidly clamped to the lathe chuck. To the protruding end of the shaft is fixed an adjustable grooved frame for holding the four segments of a cast aluminum concentric coil winder and a bolt which trips a revolution counter with each turn. The adjustable end frame is an assembly of three salvaged small motor rails with shop-milled mounting slots.

Lathe is used as auxiliary coil winder by inserting steel shaft through headstock and clamping it with lathe chuck. Hinged plank frame carries motor for driving lathe and the necessary pulleys. Turnbuckle regulates inclination of frame and tension of belt. Rubber grommets eliminate frame vibration.



Small motor bearing replacements are made on this compact workbench at the Koontz-Wagner Electric Company, South Bend, Indiana. Everything needed for the job is within easy reach of the mechanic.

Baking Lamp Assemblies

"With four of these baking lamp stands or assemblies, I can bake anything from drill armatures up to 50 hp. motors. As a matter of fact, since I made them we have hardly started up the bake oven at all, which among other things eliminates all fumes attendant upon use of the oven." H. W. Myers of the Myers Electric Co., Salt Lake City, Utah, made the above statements.

The standards are 21 inches high and are made from the ends of metal fence posts welded to small rectangular bases. The cross-section of these posts is U-shaped, the sides of the U being flanged at the edge. Holes were drilled

Perhaps Your reputation hangs by a cord

The finest appliance ever made is helpless if a weak-kneed cord and plug fail to stand up under aging and hard usage. The fact that PWC cord sets won't let a good product down explains why you'll find PWC on the plugs of so many of America's best and most famous makes of radios and electrical appliances.

PWC cords retain their handsome colors, high gloss, and flexibility. They resist grease, chemicals, and age which cause so many cords to fray, rot and crack. That's because they are not only plastic insulated, but developed and made by the men who know plastic best — the world's largest exclusive maker of plastic insulated wire and cable.

PWC MEANS 10 WAYS BETTER

1. Superior dielectric strength.
2. Can't fray, crack or rot.
3. Low moisture absorption.
4. Greater mechanical strength.
5. Higher abrasion resistance.
6. Flexible over wide temperature range.
7. High chemical resistance.
8. Wide range of permanent, gem-like colors.
9. Non-combustible.
10. Lasting appearance.

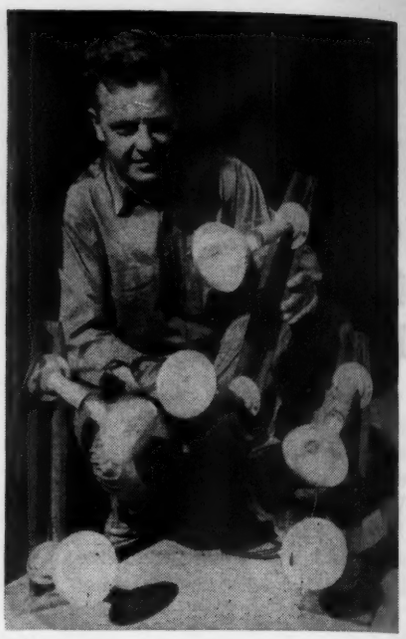
Take a tip from a PWC Cord Set . . .

Tailor-made, for every application, special electrical, chemical and physical characteristics are engineered into all PWC products... flexible cords, multiple conductors, telephone wires, radio wires, power cable, building wire, apparatus and machine tool wire, coaxial cable, shielded cables, special purpose wire and cable.

Send us your requirements and let us show you the gains from using PWC-engineered products. Our production facilities are geared to meet your needs.

PWC

PLASTIC WIRE & CABLE CORP.
403 East Main Street
Jewett City, Connecticut



H. W. Myers with baking lamp assemblies.

top and bottom through these flanges, and by means of small bolts and nuts, two "Swivelier" adjustable sockets, made by the Swivelier Co. of New York, N. Y., are fastened as shown in the photograph. In these socket reflectors, infra-red No. 200 lamps are used, 250 watts each.

"The whole unit can be set close to the work and the lamps adjusted to play on any part. I use anywhere from one to all four, depending on the work to be done," Mr. Myers concluded.

Streamlining The Pick-up

Superior Electric Works, Los Angeles, own a half-ton Ford pick-up truck with flat bed body for making deliveries and picking up work. The truck was originally fitted with ordinary stakes on the sides of the bed.

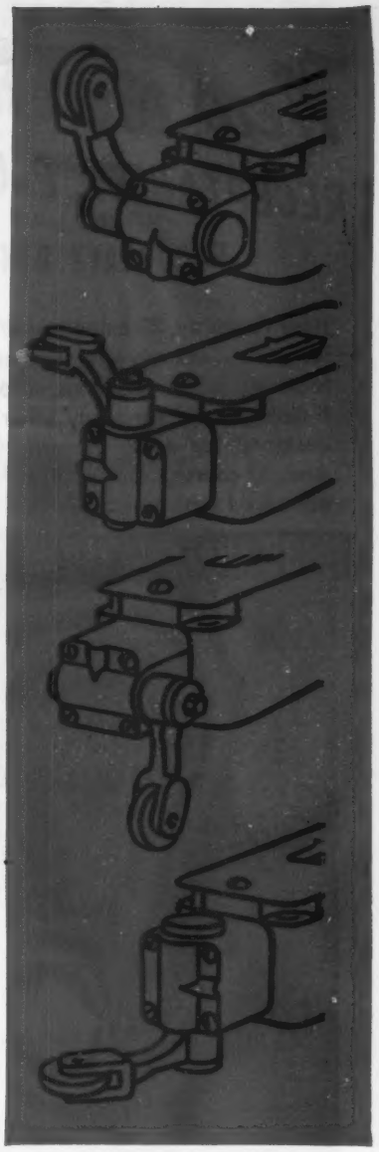
In handling motors, transformers and other heavy equipment onto the truck, they experienced no difficulty at their own shop, because they have an overhead crane, the back of which extends out over the alley. But at the customer's end, a lot of difficulty and much heavy lifting were often encountered.

Glen Boehmer, general manager, then figured out the following scheme which works very satisfactorily. Heavy sideboards of 2 in. by 12 in. oak plank were made, with short cross pieces fitting the original stake holes. A similar heavy end-board is also provided.

The sideboards are beveled and steel-shod at the rear end and are fitted with

STOP!

THIS SNAP ACTION LIMIT SWITCH HAS MANY FEATURES, MANY USES



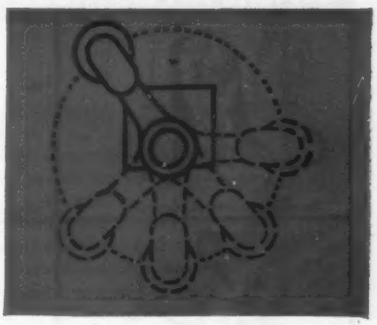
Operating head mounts in any of 4 positions, top, bottom, right or left shown above.

The Cutler-Hammer Bulletin 10316 Limit Switch, available in roller lever, push roller or push rod operating heads, all of which are interchangeable, meets many different needs on machines, machine tools, cranes and hoists. The roller lever type is furnished either with trip in both directions or with trip in one direction and by-pass in the other direction.

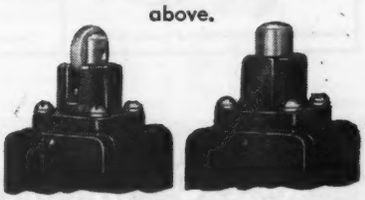
The operating head mounts in any of 4 quadrants. The roller lever can be set positively in 90 different operating positions (4° apart). Thus any machine mounting or field requirement is easily met.

Each switch has two circuits: normally open and normally closed. Adjustable contacts provide various arrangements of overlap, or no overlap. Switch can be used to initiate automatic cycles, to reverse motor or as a stop on overtravel.

Construction is exceptionally sturdy with large bearings and hardened surfaces. Twin break silver to silver contacts, quick make and break, unvarying tripping points. Maximum ease of wiring, adjustment and accessibility. Standard, dustproof, dusttight, watertight or oiltight enclosing case. Complete details on request. . . . CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin.



Roller lever may be set in any of 90 different positions, 4° apart as shown above.



Push roller or push rod operating head also available.

CUTLER-HAMMER
MOTOR CONTROL
C-H

New EVER-LOK
RECEPTACLES, PLUGS & CORD CONNECTORS

FOR HEAVY DUTY AND HIGH CYCLE APPLICATIONS

Here's a sturdy, 30 ampere, 440 Volts, A.C., capacity unit that means more jobs for you . . . more profits from installations everywhere . . . in industrial plants, factories, office buildings, department stores, hospitals, hotels, institutional buildings, and for many other heavy duty and high cycle applications. It's designed for easy, convenient wiring connections, and quick accessibility. And, of course, built by Russell & Stoll means the finest, sturdiest, and most advanced type unit available.

30 AMPERES, 440 VOLTS, A. C.

Serrated . . . wire stays permanently . . . no forming of wire over terminals
Strong, sturdy Spring keeps door closed and dust-tight.
Durable, fully protective, Hinged Cover and Gasket.
Adjustable Cord Grips eliminate strain on connections.
Compact design provides for large capacity and allowing ample room for wire connections.
Heavy duty, rigidly constructed Receptacle.
Rugged, Solderless Terminals . . . an exclusive EVER-LOK feature.
Heavy steel shield for protecting contacts.
Contacts are precision-machined, self-wiping, and self-aligning.

This Bulletin explains and illustrates the many EVER-LOK features, lists detailed ordering information, prices, etc. *Write* for Bulletin EL446-4

TYPICAL APPLICATIONS for EVER-LOK 30 AMPERE, 440 VOLTS, A. C., RECEPTACLES, PLUGS AND CORD CONNECTORS

For connections to Electric Hammers.
For connections to heavy duty Sanding Tools.
Connected to high power Grinders.
Connected to Floor Polishing and Waxing Machines.
Connected to heavy duty Electrical Drills, etc.
Connected to large Vacuum Cleaners.

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SINCE 1902

RUSSELL & STOLL COMPANY, INC.

Precision-Built Electrical Equipment

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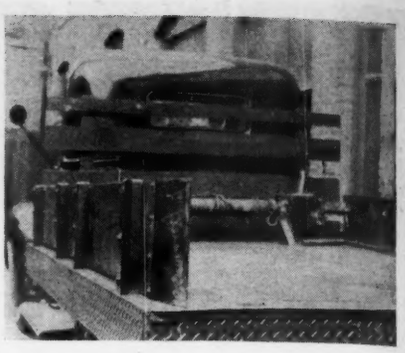
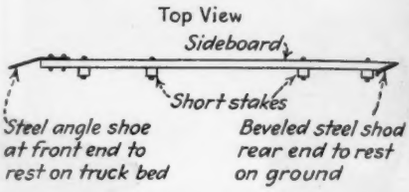


Sideboard and winch on streamlined truck used by Superior Electric Works of Los Angeles, Calif.


Top View
Sideboard
Short stakes
Steel angle shoe at front end to rest on truck bed
Beveled steel shod rear end to rest on ground

Truck sideboards are steel shod both front and rear to serve as equipment ramps.

a steel angle shoe at the front end. When a heavy machine is to be loaded, the sideboards are taken off and laid from the rear end of the bed to the ground as an inclined runway up which the machine is dragged, on skids or rollers as the case may be. The sideboards are 7 ft. 6 in. long over all, so the incline is not too steep.

To do the pulling, a winch is rigged on the truck bed just back of the cab. This is hand operated, with a crank, the crank being geared to the shaft through an old Chevrolet '31 transmission. This gives three speeds forward, and the neutral position is used for pulling cable in unwinding. The end of the shaft opposite the transmission is filled with a ball bearing.

No remodeling of the truck bed was necessary, but a light 1-inch strip of angle was welded across the rear edge of the bed to hold the steel shoes of the sideboards.

Incidentally, when the sideboards are in their regular positions on the truck, the steel angle shoes on the forward ends, which flare outward slightly, pick up enough breeze and direct it back over the truck bed to blow out dust and light refuse, so that the boys are saved considerable "broom work", which they seem to appreciate.

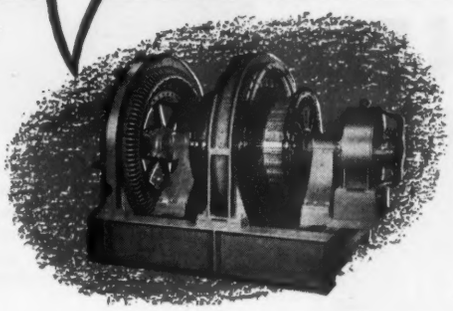
Portable Turntable For Heavy Motors

Elimination of employee fatigue and back-breaking chores is one of the features of the heavy motor handling system developed at the Koontz-Wagner

SPECIALIZATION MEANS PROVED PERFORMANCE

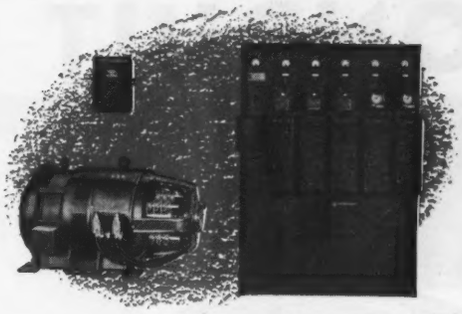
● For 35 years, The Electric Products Company has specialized in the manufacture of High-Current, Low-Voltage Motor-Generators and other special electrical equipment. The result is Proved Performance . . . an assurance of lower-cost operation, higher operating efficiency and more dependable life-time service. For every application, E.P. designs and builds equipment that fits exactly the requirements of the particular operation.

FOR EXAMPLE:



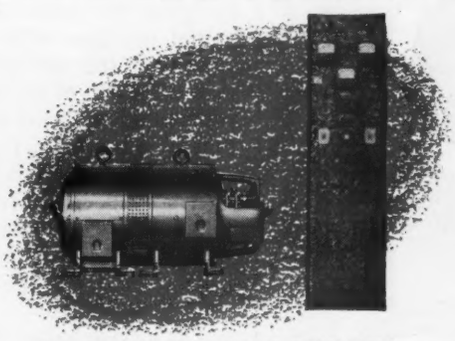
FOR ELECTROLYTIC PROCESSES

E.P. Electrolytic Motor-Generators employ *Undercut Commutator Mica* to prolong commutator and brush life; *Pole Spacers* to help assure sparkless commutation; *Micrometer Adjustment of Interpoles,* an exclusive feature, to guarantee outstanding performance; *Correct Mechanical Design* that means every part of the motor-generator is swept by a cooling stream of air; and *Fully Accessible Construction* for easy inspection.



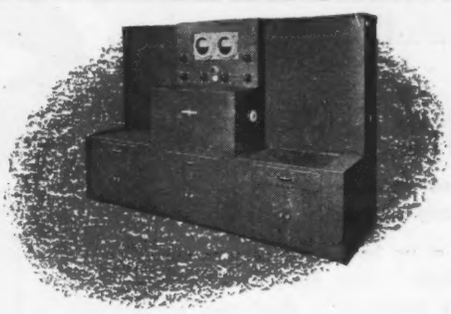
FOR INDUSTRIAL-TRUCK BATTERY-CHARGING

In 1910, The Electric Products Company introduced the first Automatic Battery Charger. Today they most efficiently and advantageously combine: completely automatic operation . . . the modified constant-voltage method of charging . . . individual application design . . . elimination of complicated control or ventilating systems . . . and specialized low-voltage designing.



FOR STANDBY BATTERY-CHARGING

Since 1923, Diverter-Pole Motor-Generators have proved to be the most reliable, maintenance-free and efficient source of direct current for Control Bus Battery Charging. They assure maximum battery life, give full-automatic operation and protect themselves against harmful overloads. Requiring only infrequent inspection, they are extensively used in isolated automatic and supervisory-controlled substations.



FOR INDUSTRIAL TESTING

The design and manufacture of Dynamometers, because of the very high operating speeds and the severe continuous-duty loads, require a manufacturing skill far beyond that needed for conventional equipment. The Electric Products Company has developed this background. Features include oversize bearings, heavy supports and framework, special commutator and armature construction.

● **Get the Facts on these and other E.P. Products . . .** For complete information, please contact your nearest E.P. representative or write to the address shown below:

EP

X-29

THE ELECTRIC PRODUCTS COMPANY

1734 CLARKSTONE ROAD CLEVELAND 12, OHIO

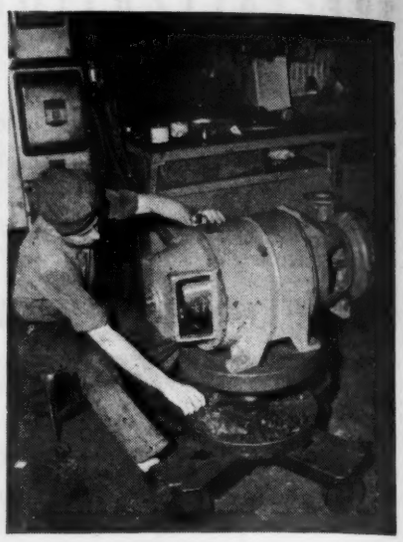
"UNION"
INSULATED
CONDUIT END
BUSHINGS
Molded of Impact Resisting Bakelite!

1. Threads are smooth, concentric and free of burrs.
2. Provided with ribbed grip for easy tightening by hand or tool.
3. Inside of lip beveled to remove cutting edges. Thus danger of injury to wire insulation is eliminated not only when wires and cables are "pulled" but after installation.
4. "Union" Insulated Conduit-End Bushings economically prevent costly grounds and short circuits. Particularly desirable in industrial locations. Vibration often damages wire insulation where sharp edges are contacted.

PRICED TO MAKE INSULATED BUSHINGS PREFERRED

Compare!

UNION INSULATING CO., INC.
PARKERSBURG, WEST VIRGINIA



Turntable stand for motor testing, disassembly and assembly at the Koontz-Wagner Electric Co., South Bend, Indiana. Unit consists of two discarded drill press tables mounted to a heavy duty portable base.

Electric Company motor repair shop in South Bend, Indiana. Near the shop's truck entrance are several portable turntable stands on which incoming motors are set. They can then be quickly and easily moved to the test board or any other part of the shop.

Typical of the "turntables" used is the one illustrated above. Two 20-inch diameter scrap drill press tables mounted back-to-back on a caster base comprise the essential parts. An inverted bell-type collar welded to the bottom of the top table fits over the stub extension of the bottom table and rests on a ball thrust bearing. The bottom table is welded (or can be bolted) to a heavy duty X-frame made of double 2-in. by 2½-in. angle irons welded to 6-inch steel casters. Two right-angle "ears" on the frame accommodate a V-shaped steel rod handle for pulling the unit.

The mechanic can sit on a low stool while taking apart or assembling the motor.

Boosters for Sullivan County, New York, are electrical contractors A. W. Whittaker, South Fallsburg, and Bernard Deutsch, Liberty, who attended the Eastern Section, IAEI, annual meeting held in Atlantic City, N. J.

Modern Lighting

Planned Simplicity Gains Multiple Aim

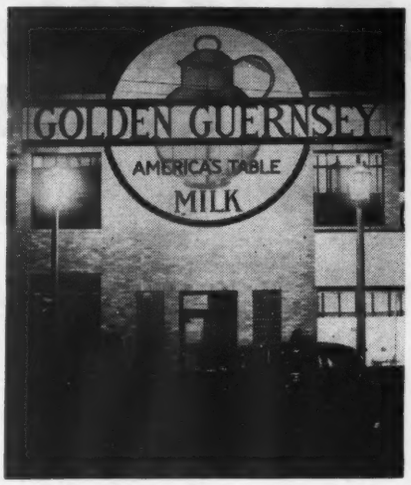
Modern merchandising requires illumination that provides an even distribution of general lighting for a restful and cheerful atmosphere, higher levels of lighting on sales areas and displays to direct customer interest and present merchandise effectively, and blended color to lend warmth and interest to the displayed goods. These objectives are achieved in the simple lighting installation in the Brown-Dunkin Department Store of Tulsa, Oklahoma, where two types of recessed fixtures combine soft, shielded, general lighting; high-lighting provisions, and color conditioning.

Both units, manufactured by Edwin Guth of Saint Louis, Missouri, and specified by lighting engineer A. de'Espenza, Lawson Electric Company, Tulsa, are recessed into the 12-foot ceiling. Shallow troffers are used as single units, spaced three feet apart from end to end and 7 feet between rows. Each unit contains two 40-watt white fluorescent lamps, shielded by eggcrate louvres. Accent lighting and color correction is provided by square, recessed metal housings having circular mounting rings and provisions for adjusting the angle and direction of 150-watt incandescent PAR lamps. The use of these Hy-Liters makes it possible to concentrate high levels of illumination on seasonal or special displays and quickly adjust the units to meet changing requirements. After 800 hours of use, light meter readings revealed levels of illumination on counter tops of from 40 to 50 footcandles intensity. Merchandise in glass sales counters is further illuminated by slim fluorescent lamps in narrow counter reflectors. Wall displays and stock shelves behind sales counters are top-lighted by standard, 40-watt, fluorescent lamps.

General illumination is provided in the Brown-Dunkin Department Store of Tulsa, Oklahoma, by recessed fluorescent units mounting two 40-watt lamps behind eggcrate louvres. Color correction and accent illumination for feature displays is provided by adjustable recessed incandescent units utilizing 150-watt PAR-38 lamps. Lighting levels range between 40 and 50 footcandles intensity on sales couter tops.

Special Lighting Units Combat Shadows

While enlarging and modernizing their milk bottling facilities in upstate New York, the Guernsey Company was faced with the problem of determining the most effective method for lighting one of their exterior signs. The sign, displaying a Colonial milk jug in a circular frame with superimposed lettering, was constructed of vari-colored tiles protruding from the brick face of one of the recently-constructed buildings. With natural daylight illumination, the sign appeared three-dimensional but, due to the protruding tiles, lighting the sign after dark produced heavy shadows and distortion when floodlights were located above, beneath or to either side of the sign.



Floodlights, mounted in ornamental street lighting standards, direct light to sign composed of vari-colored tiles protruding from face of building.

It was decided that lighting, to be effective and to eliminate shadows, should be from the front. Also, for appearance, it was desired to keep the face of the building as free as possible from special floodlight brackets or special mounting arrangements. On the recommendations of Hillebrand and Owen, electrical contracting firm of Syracuse, New York, two standard street lighting standards were adapted to this special purpose. The standards, located just inside the curb line on either side of the front entrance, now contain floodlights that direct light directly toward the center of the sign. Since the light strikes the tile at a more direct angle than the normal line of vision of motorists or pedestrians, shadows become unnoticed and distortion of letters and curves is eliminated. Small auxiliary lamps in the street fixtures illuminate the globes, giving a normal appearance to the units. Few suspect the dual lamp arrangement and are only conscious of an attractive and effective arrangement of ornamental lighting standards, a modern building facade and the clean, simple, well-lighted sign.

A Sensational NEW

Small Size · Big Quality
Wide Application
High Accuracy · Low Price

Unusually small—entirely new—the Sangamo Type S Time Switch is an accurate, attractive product of Sangamo's 20 years of experience in making quality time switches. It is powered by a newly developed Sangamo high torque, synchronous, self-starting, low-speed motor that is lubricated for life.

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The new Sangamo Type S Time Switch is available for immediate delivery at your electrical wholesalers.

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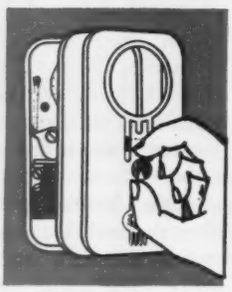
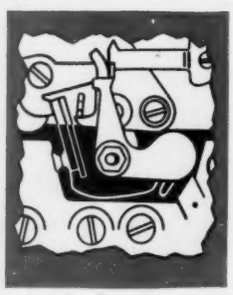


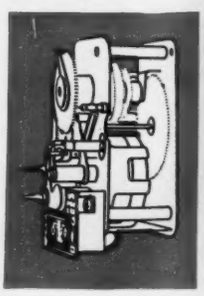
Cover Readily Removed

Operations Easily Adjusted

Dead Front Safety Design



Long-Life Silver Contacts



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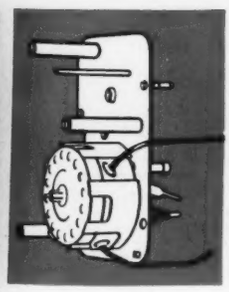
Available in two attractive colors, Brown or Ivory. Type S has one "ON" and one "OFF" operation. Type SR has two "ON" and two "OFF" operations. Ivory Case and Type SR Switches are priced slightly higher.



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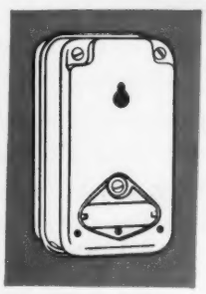

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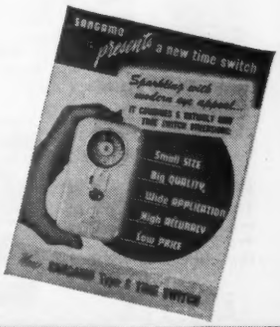

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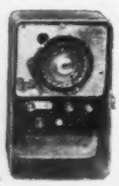

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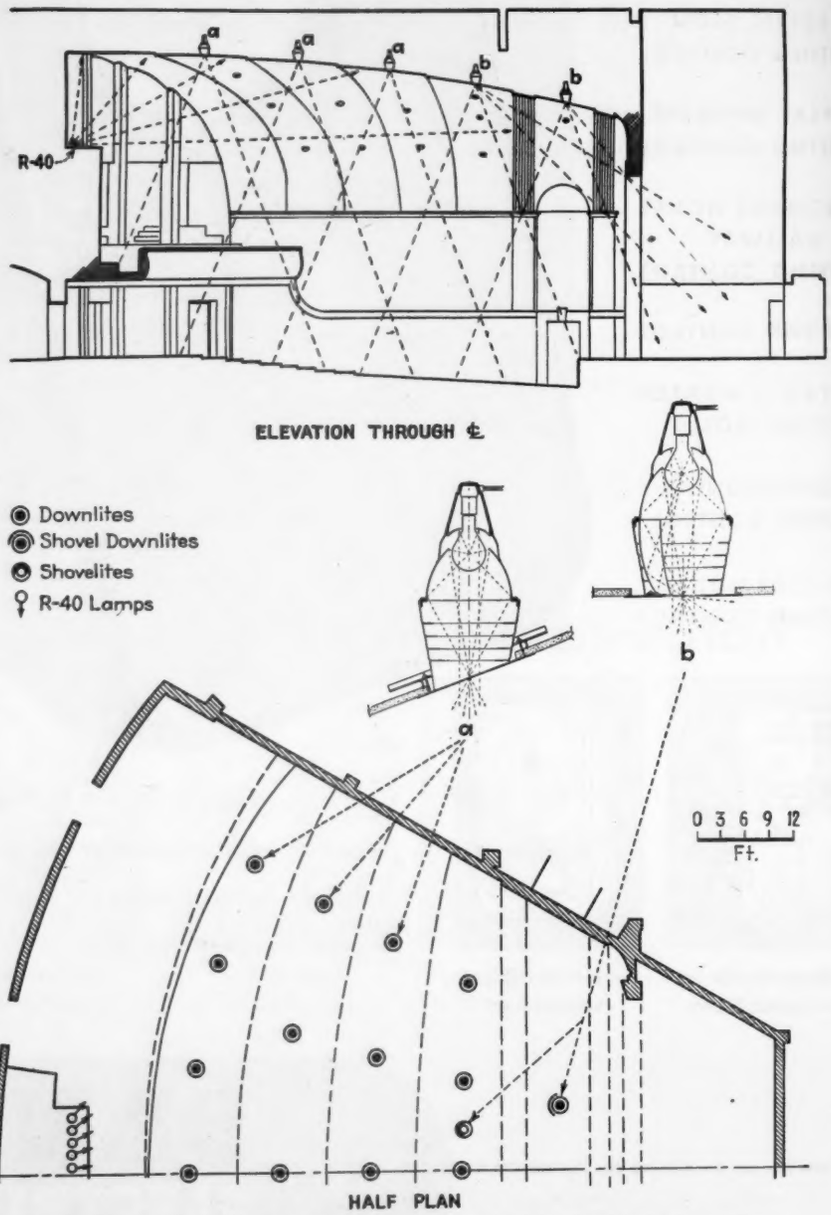
Modern Lighting For Modern Auditorium

The auditorium pictured here is in the Cardinal Hayes Memorial High School for Boys, Bronx, New York. Its architectural treatment is of pleasing modern design and typical of today's advanced trend.

Lighting for such an auditorium must also be modern. It should emphasize the architectural lines and spacious interior. It should also provide adequate illumination of a well diffused character for the varied purposes for which such auditoriums are used. Light sources should be concealed, or unobtrusively made a part of the structure. All of these requirements have been amply met in this high school auditorium.

The auditorium is fan-shaped, with a 32-foot deep by 41-foot wide stage in the apex. The width of the auditorium is 55 feet at the front, and 110 feet at the rear. The depth is 69 feet from the rear wall to the proscenium. A balcony curves around the entire arc of the rear. The ceiling is composed of a series of curved and arched panels of varying widths, painted white to the springline, with gray walls to the light mahogany wainscoting. The ceiling height varies to 36 feet at the rear center.

Exposed luminaries not only would be out of place in the smooth flowing lines of the design, but would interfere with the well designed accoustical treatment. Thus, a concealed system of lighting was selected to provide the desired lighting result. This system is approximately 90 percent direct, from ceiling recessed downlights, and 10 percent indirect, from a bank of reflector type lamps concealed above the pro-



Elevation and half plan show location and light distribution of Rambusch lighting units used to provide general illumination of eleven footcandles maintained in service in high school auditorium.

Specify "Alzak* Reflectors" for the lighting that you buy. You'll get the most lighting efficiency for your dollar . . . reflectivity up to 87%, no attack by most corrosive atmospheres, no spalling if dented, easy to keep clean and bright, available from leading manufacturers of quality lighting equipment.

And order your Alzak Reflectors equipped with lightweight Alcoa Aluminum Housings and Tubular Hangers . . . they lessen the dead weight on ceilings and joists. Stay bright and attractive without painting or plating.

You can get Alzak Reflectors from leading lighting manufacturers . . . don't forget to specify "ALZAK". For names of manufacturers of Alzak Reflectors, write to ALUMINUM COMPANY OF AMERICA, 1946 Gulf Bldg., Pittsburgh 19, Pa. Sales offices in 54 leading cities.

*Registered trade-mark and patented process

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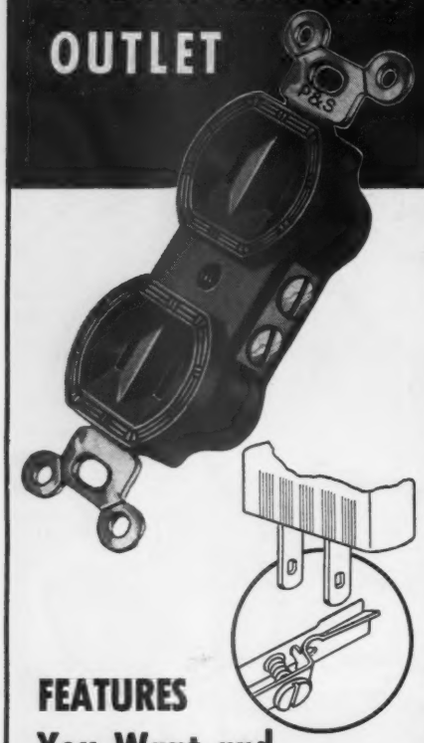

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- Large Binding Screws *(ample for No. 10 wire)*
- Deep Finding Slots *(for easy insertion of plug caps)*
- Uniline Border Design *(for attractive finished appearance)*

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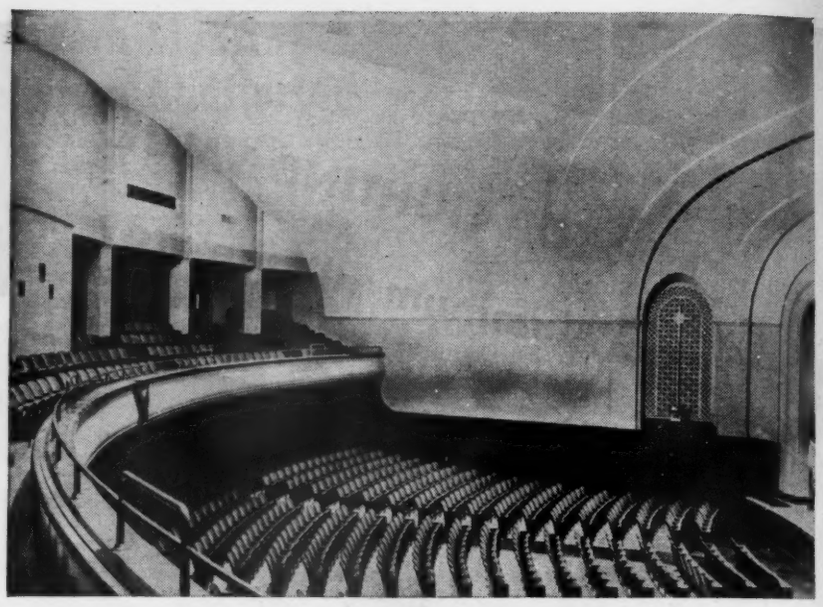

Concealed lighting equipment provides comfortable illumination and emphasizes the modern design of the Cardinal Hayes Memorial High School for Boys auditorium, located in the Bronx, New York City.

jection booth at the rear of the auditorium and over the balcony. The direct lighting consists of 24 downlights, each using 500-watt inside frosted PS-40 lamps, and designed to be installed vertical in the double curvature ceiling locations. The indirect lighting is provided by ten 300-watt R-40 lamps installed on universal swivel bases so that each unit may be individually adjusted to provide uniform lighting over the entire ceiling. The average illumination in the auditorium, measured after nine months, is over eleven footcandles.

Two 500-watt and two 1000-watt downlights, each equipped with auxiliary "shovel" reflectors on the side of the units opposite from the stage, were used to light the proscenium and stage area. Horizontal illumination from these units is 15 footcandles on the stage, and the vertical illumination on the proscenium is twelve footcandles. Regular stage and spotlighting is also provided for the stage in addition to the lighting system described here. The area under the balcony is also illuminated with conventional type units, which were not lighted when the accompanying picture was taken.

The entire lighting system is dimmer controlled, to permit varying intensities to be obtained, and to provide smooth dimout for theatrical productions.

Rambusch Decorating Company planned this modern lighting system in cooperation with Eggers & Higgins, architects, and furnished the equipment described. Syska and Hennessy were the consulting engineers.

The largest department store in Oklahoma, Vandevers of Tulsa achieves diffuse, general, high-intensity illumination through the use of Guth fluorescents. Of brass and steel finished bronze, with white reflectors and louvres, each fixture mounts eight 40-watt lamps. Single fluorescent lamps, mounted behind the upper lips of wall cases, highlight local displays in these areas.

The Curtis anniversary luminaire delivers satisfaction ★

They're talking about it . . . architects . . . contractors . . . customers and maintenance men . . . they like it!

Yes, architects like the Anniversary Luminaire because its simple lines and fine proportions fit in well with practically any interior. Contractors like it because it's easy to sell and install . . . it helps them get the profitable orders. And the customer . . . he's pleased with the smooth even light distribution as well as the compliments he gets on his smart choice. Then there's the maintenance man . . . he's tickled because lamp renewals and cleaning can be completed in a jiffy . . . without even removing the louver.

We predict that if you have all the data on this Anniversary Luminaire, you'll quickly appreciate all the advantages it offers you.

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ROYAL FUSES

ROYAL ELECTRIC CO., Inc.
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Low brightness ceiling is achieved by recessing continuous 2-lamp fluorescent troffers into the acoustical tile ceiling at right angles to the normal line of vision. Mounted on five-foot centers, the runs of 3500-degree white light deliver an average intensity of 62 footcandles to desk levels.

Deep Troffers For Offices

Custom built troffers of deep design are recessed into the acoustical tile ceiling of the Allen G. Wrisley Company's Chicago offices to provide continuous runs of low brightness fluorescent lighting. After 1500 hours of service, the footcandle intensities at desk levels averaged 62, resulting in a coefficient of utilization of 27 percent. The troffers are mounted on 5-foot centers and contain two lines of 40-watt white fluorescent lamps mounted end to end. Troffers, with Alzak aluminum reflectors, have longitudinal cutoff angles of 45 degrees. The physical dimensions of the office space are 100 by 130 feet with a 12 foot ceiling elevation. In all, 480 Guth recessed troffers are installed throughout the area. The connected light load approximates 5 watts per square foot of illuminated floor area.

With longitudinal rows of lamps mounted at right angles to the line of sight from normal desk and seating arrangements, the overall appearance of the ceiling is spacious and glare free. Since the troffers dispense with diffusing panels, maintenance is at a minimum and light output is high. With the exception of air conditioning louvres and sprinkler heads, the ceiling is unbroken, adding to the effective impression of height and spaciousness.

Meriden, Conn. was well represented at the Eastern Section, IAEI, annual meeting held in Atlantic City, New Jersey, by (l. to r.) electrical contractors A. A. Lanouette and Max L. Rischall, electrical inspector George W. Hollman and L. B. Disbrow, electrical contractor.

TELEVISION MASTER ANTENNA SYSTEMS

[FROM PAGE 55]

sure efficiency and economy. Layout drawings by the electrical contractor must show approximate location of antennas, amplifier, each outlet and all pertinent dimensions and distances.

The size of conduit depends upon the number of cables which it will carry. Since the average size of cable is ¼ in. in diameter, the size of the conduit seldom exceeds 1 in.

Care is necessary in working with radio frequency cables. Before an installation commences, a drawing showing the outlet wiring is provided. The outlet boxes must be left open, and closed only after they have passed preliminary visual and ohmmeter checks. These checks are for correct circuiting, soldering of all joints, correct resistor values and continuity and short circuits. Following these checks, surface plates can then be put on, closing the outlets. The electrical contractor then calls Intra-Video to make radio frequency measurements of outlets. In these measurements, a signal generator and radio frequency voltmeter are used to determine whether the attenuation in the outlet line is within prescribed limits. The signal generator must cover from 50 to 220 megacycles with .1 volt output across 52 ohms. The radio frequency voltmeter should be capable of measuring signals in this frequency range to an accuracy of 2 percent, at levels of from .1 to 100 millivolts. Any excessive loss of signal must be corrected at this stage. After this has been done, the amplifier can be placed in service.

From experience gained during installations completed by Brown Electric Company for the City Investing Company of New York City, it is obvious that the guide word for all installations is "CARE". Cables must be carefully run, without sharp twists or bends. Cable ends must be carefully cut and soldered. Conduit systems should be designed with minimum bends. When such care is taken, the installation of a television master antenna system is both simple and effective.

The success of television in Metropolitan areas depends upon the installation of master antenna systems for all multiple dwellings. General acceptance will definitely contribute to the realization of effective television reception.

Over 1500 hospitals in the U. S. alone have *proved* that the use of Germicidal Radiation effectively reduces respiratory infection. In homes, schools, nurseries, factories, laboratories, offices — wherever there is need for protection against air-borne bacteria — germicidal radiation is a powerful factor for preserving good health.

Designed to keep pace with giant strides made in the science of air disinfection, this new Silva-A-King Germicidal unit gives positive protection against direct radiation while maintaining maximum concentration of germ-killing energy. Easy to install and completely adaptable to any room with regular electrical outlets.

Free Literature on request. Write Dept. G-48 for Germicidal Bulletin.

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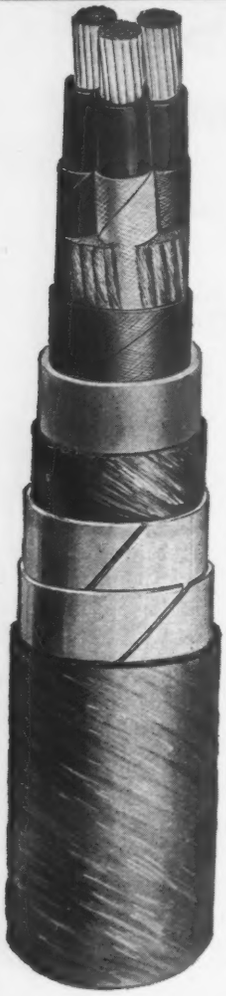

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THREE CONDUCTOR
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Or with Varnished Cambric for maximum current carrying capacity or higher voltages.

No other protection required except at points of extreme mechanical hazard. Being well protected from ordinary mechanical injury and easy to install, they provide an economical permanent underground system.

These cables are widely used for street lighting circuits, railroad yard lighting and signal systems, airport power and lighting circuits and in industrial plants and mines.

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Answered by
F. N. M. SQUIRES and GLENN ROWELL
New York Board of Fire Underwriters
Chief Inspector
New York, N. Y.
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

Questions on the Code

600 Volt Fuses on 250 Volt Circuits

Q. *Is it permissible to use 600 volts 500 amp. fuses in this situation?*

A bus rated at 600 volts 1000 amperes is feeder for two branch bus feeders, each one protected by a switch and fuse holders for 600 volts, 500 amp. fuses. The transformer supply is 220 volt, 3 phase. In order to use 250 volt fuses it would be necessary to set the fuse holders over at considerable expense.—J.H.C.

A. The Code in Section 2461 subparagraph b, states that "Cartridge fuses and fuse holders, shall be so designed that it will be impossible to put a fuse of any given class into a fuse holder which is designed for a current lower, or voltage higher, than that of the class to which it belongs".

This implies that it is permissible to use fuses of lower amp. ratings in fuse holders of higher amp. ratings and fuses of lower voltage ratings in fuse holders of higher ratings.

In the case mentioned it would be permissible to use fuses of 600 volt ratings in fuse holders of 250 volt ratings and while the Code does not specifically state that 600 volt fuses may be used on 250 volt systems, that is implied by the wording quoted above.—F.N.M.S.

Farm Wiring

Q. *Does the Code have any special requirements pertaining to the use of Romex in farm barns? I have had quite a few jobs where the outside braid has rotted off and the R.E.A. manager is considering some special requirements if the Code does not contain them.—W.H.S.*

A. No, the N.E. Code does not contain special rules relative to the use of non-metallic sheathed cable in farm barns. Under Section 3362 you will note that this wiring material cannot be used in breweries, ice plants or cold storage warehouses or in other similar locations where subject to mildly corrosive fumes and vapors or where exposed to the weather, but dairy barns, chicken houses and similar buildings are specifically exempted. Field experience in the colder climates indicates the need for special regulations in farm buildings housing livestock especially where the ventilation is substandard. Therefore if this wiring material is used in such buildings, it is advisable to follow the following recommendations to assure a safe installation:

1. Do not fasten this cable to the inside of outside walls unless it is placed on running boards furred out from the inside surface at least two inches.
2. Where passing through beams, partitions, ceilings or walls, it should be placed inside a conduit or tubing nipple and sealed with regular sealing compound.
3. Do not place this cable over doorways or other openings where cold drafts can strike it.
4. Do not pull it through ventilating ducts unless enclosed in sealed pipe or tubing.

Possibly the wire mills will develop a new type of cable assembly which may be safely used without taking these special precautions, but until they do we had best be cautious and make use of the field experience now accumulated.—G.R.

Fluorescent Load Computation

Q. *How would you compute the load of a fluorescent circuit and is the square foot rule in effect on such a circuit?*

Where will this be found in the 1947 code?—C.R.M.

A. The load of a fluorescent circuit is computed on the same basis, using the same factors as an incandescent lamp load. The computation is based on the square foot area and the rules of Section 2116 of the Code apply.

Some engineers state that the current load is less with fluorescent lighting while others maintain very stoutly that with the much higher level of illumination generally used with fluorescent lighting, the current load is much greater.

Evidently a great many people want more light now-a-days.—F.N.M.S.

Motor on Fuel Oil Pump

Q. *We have been asked to install a motor on a fuel oil pump located in an underground oil storage room. The specifications do not call for an explosion-proof motor, but we are wondering if it will not be required by the Code. Can you advise us whether or not the special motor is necessary?—H.S.*

A. Most fuel oils have a flash point of approximately 150 degrees Fahrenheit, some may have flash points as much as 25 degrees less. However, it is not likely that a tank room will have an ambient temperature as high as 125 degrees Fahrenheit. No flammable liquid will vaporize fast enough at temperatures below their flash point to form explosive mixtures with air, so unless the ambient temperature within the tank room is likely to reach or exceed the flash point of the fuel oil the room need not be considered a Class 1 Group D location.

Heavier fuel oils must be heated during cold weather, and in some instances this is accomplished by heating the entire tank room. Where this is done, it is possible to find temperatures which might even exceed the flash point of the oil and in such a case the room would have to be considered a Class 1 Group D location.—G.R.

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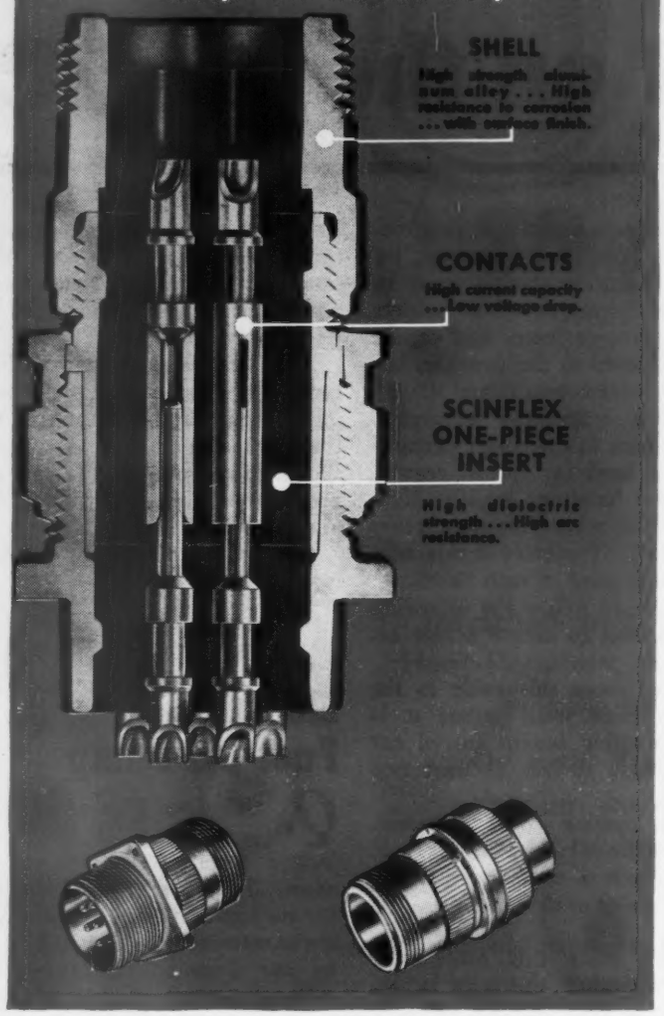
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Bare Neutral

Q. *The question has been raised regarding the use of a bare neutral installed in rigid conduit between the main switch and distribution box (a distance of 30 ft.) which contains connections for another building on the same property as well as the panel for the cottage in which the service is located.*

Article 3382 seems to approve the use of service entrance cable with bare neutral, either armored or unarmored, for this purpose. If this is so, it would seem logical that the use of bare neutral in conduit would be more desirable.

The service in question is 3 wire 120-240 volt installation located in the cottage basement and supplies the main house through underground conduit.

What is the ruling on this?—A.N.

A. Section 3382 states that approved service entrance cable may be used for interior wiring if *all* of the conductors are insulated with rubber or thermo-plastic insulation and may be used with uninsulated neutral for range and domestic water-heater circuits, or as a feeder from a *master service cabinet* to supply other buildings or as service-entrance conductors for other buildings, *if* the following conditions are met:

a. The cable has a final non-metallic outer covering.
b. The supply is alternating current not exceeding 150 volts to ground.
c. The bare neutral is not used as one of the circuit conductors for the domestic water-heater circuit.

This therefore, would not permit the use of a bare neutral in conduit on the house side of the service switch, as in the feed from the service switch to the distribution panel. Nor does this permit the use of the bare neutral type of service cable for the feeder from the service switch to the distribution panel nor for the feeder to the cottage circuit panel.—F.N.M.S.

Wiring A Grain Elevator

Q. *It is my understanding that an ordinary pressed steel outlet box may be used in country grain elevators provided it is used as only a pull or splice box. On the last job I installed, the inspector has demanded the use of bonding jumpers or threaded hub boxes and I had thought double lock nuts were all that was required. What does the Code require?—G.R.*

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A. Section 5054a states that wiring shall be in rigid metal conduit with threaded boxes and fittings for Class 2 Division 1 locations. Most areas within a country grain elevator would definitely be a Division 1 location. This does not mean that the boxes have to be of the dust-tight type, so ordinary condulet fittings may be used where non-conductive dusts, such as those found in a grain elevator, are present.

Then under Section 5066 you will also note that the double lock nut and bushing combination cannot be depended upon for assuring electrical continuity of the raceway system.

The 1940 Code did not contain any reference to the threaded boxes and fittings and while it may not have been the intent of the Article 500 Committee to permit the use of ordinary outlet boxes in nonconductive dust laden atmosphere, they were generally accepted provided grounding continuity was assured by an approved means. This no doubt is the reason your inspector asked for the bonding jumpers as an alternate for threaded hub boxes. —G.R.

Fluorescent Fixtures on a Circuit

Q. *How many four light 40 watt fluorescent fixtures are permitted on a 15 ampere circuit, using twin high power factor reactors?—C.M.*

A. The two tube high power factor ballast gives a line current of about 0.85 amperes.

This means that each four light 40 watt fixture consumes about 1.7 amperes. Therefore 8 such fixtures could be put on a 15 ampere branch circuit provided the light were not under continuous operation. The 8 fixtures on a circuit could be used for dwelling occupancies.

Where the use of lighting is to be continuous for several hours as in store lighting, the load on a 15 amp. branch circuit must not exceed 12 amperes and here only seven such fixtures could be used.—F.N.M.S.

Q. *How many one light 40 watt fluorescent fixtures are permitted on a 15 ampere circuit using a single high power factor reactor?—C.M.*

A. The high power factor single light 40 watt ballast gives a line current of about 0.5 amperes.

Therefore 30 of these could be used on a 15 ampere branch circuit in a

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RIDGID No. 65R offers near machine-speed in threading 1" to 2" pipe

● It's unusually fast and easy for two reasons. You save on get-ready—10 seconds sets it to pipe size (1," 1¼," 1½," 2"), both chasers and workholder. And it threads any kind of pipe or conduit fast with surprisingly little effort—precision-made high-speed tool-steel dies that stay in the efficiency-balanced die stock. Factory tested—test sample in each tool. Buy No. 65R—at your Supply House.

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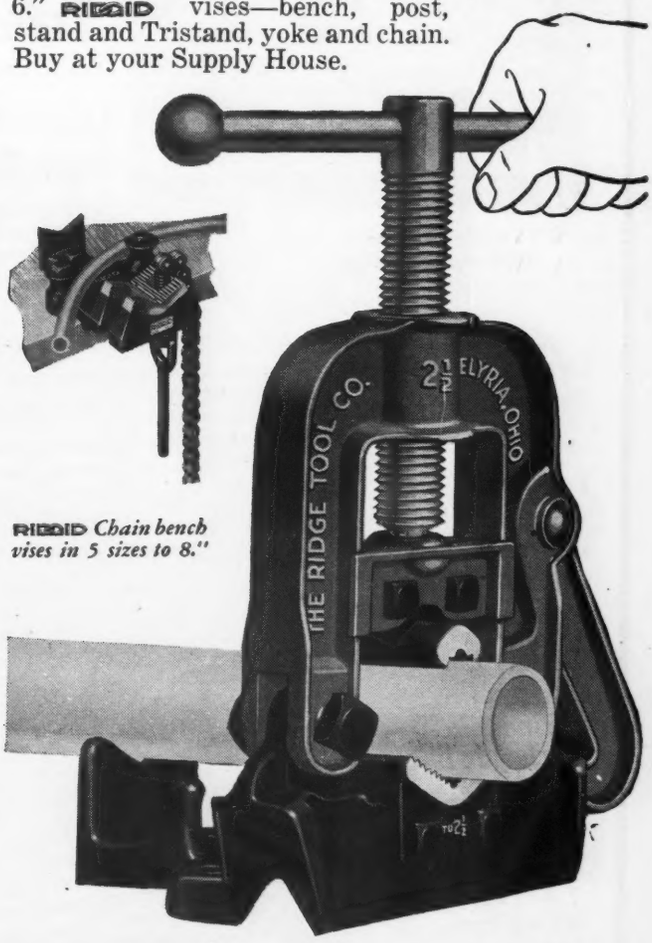
● Look for red yoke RIDGIDs and you find vises that make your pipe and conduit work easier, more efficient. Integral pipe rests support pipe firmly for threading and cutting. Handy built-in benders won't flatten pipe. Tool-steel LonGrip jaws grip solidly but protect polished pipe. 8 sizes for pipe to 6." RIDGID vises—bench, post, stand and Tristand, yoke and chain. Buy at your Supply House.



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Pioneers in the development and manufacturing of Air-Cooled transformers.

dwelling and not more than 24 on a continuous lighting load.

The low power factor 40 watt ballast gives a line current of 0.75 amperes and not more than 20 should be used on a circuit for house lighting and not more than 16 on a circuit for continuous duty.—F.N.M.S.

Residential Wiring

Q. *Can you explain the proper method of determining the number of circuits required by the Code for one family homes? We will appreciate any assistance you can give us as we may be required to change a number of completed jobs if we really are wrong as the inspector claims.—R.M.C.*

A. Minimum requirements are based on two watts per square foot. The square footage of a dwelling is computed from the outside of the building times the number of floors and should not include the floor area of open porches, garages nor unfinished spaces in basements or attics.

A one story dwelling having a full basement but no second floor, 34 feet wide and 50 feet deep will contain 3400 square feet of floor space. The total load will be 3400x2 = 6800 watts. 6800 ÷ 115 = 58 amperes ÷ 15 = 4 circuits. Then in addition at least one appliance circuit is required so the total minimum number of circuits acceptable to the Code in this dwelling would be five. This used to be shown in example form in the N. E. Codes, however, shortage of paper has made it necessary to leave the examples out of the 1947 edition. You will note under Section 2115 a recommendation that dwelling illumination be based on three watts per square foot. This, however, is not mandatory.—G.R.

Jack J. Reddington, electrical contractor of Boston, Mass., welcomes inspector Frank Lintz, Quincy, Mass., to 23rd annual meeting, Eastern Section, IAEI, held in Atlantic City, N. J.

In the News

NISA Employs Staff Engineer

Another page in the progressive history of the National Industrial Service Association was recently written when the Directors through a special committee selected and hired David Ward Rust as an engineer on headquarters staff.

A graduate of Iowa State College, Mr. Rust has degrees in electrical and mechanical engineering. While an undergraduate he majored in alternating current machinery, transmission engineering, machine design, heat transfer, refrigeration and air conditioning. He gained practical experience as an electrician, armature winder, shop engineer, sales engineer, heating and electrical engineer for numerous engineering firms. Among them were Jack Pilmer's Industrial Engineering and Equipment Company at Davenport and Electrical Engineering and Equipment Company at Des Moines.

David Ward Rust is the newly appointed staff engineer for the National Industrial Service Association. He will be stationed at the national headquarters in St. Louis where he will compile technical and engineering data for the association.

Prior to our entry in World War II, Mr. Rust was inspector of engineering materials for the U. S. Navy and for three years was a chief specialist in the Navy.

Mr. Rust's first assignment on the NISA staff is to assist Frank Willey in compiling and issuing the three-phase data for the NISA Rewind Data Book. Then he will work with Ed Grant at the Tennessee Electric Motor Service in Nashville compiling single-phase data for the book. Following completion of these assignments, he will be stationed with Mr. Wipperman at the National Headquarters in St. Louis where he will compile engineering data for distribution to the membership.

The committee is emphatic in its assertion that the staff engineer cannot do individual shop engineering. All his efforts are to be concentrated on projects handled by headquarters that will be of mutual benefit to all members.

Attending the 23rd annual meeting of Eastern Section, IAEI, in Atlantic City, N. J. were Baltimoreans Wm. Miller, supt. elec. dept., Board of Fire Underwriters, T. M. Bartholomee, Metered Instruments Dept., Consolidated Gas Electric Light & Power Co., and Donald Broome, electrical contractor.

IES Sponsors Lighting Courses

"Advancement of the theory and practice of illuminating engineering and the dissemination of knowledge relating thereto" is one of the major objectives of the Illuminating Engineering Society. In the dissemination of lighting knowledge, the various Sections and Chapters of IES include the sponsoring of educational courses in lighting as part of their normal activities. The following round-up of these activities shows not only success in achieving their objective, but indicates a widespread desire for greater knowledge of lighting by lighting equipment salesmen, electrical contractors, plant engineers, architects, decorators, lighting equipment manufacturers, electric utility men, and many others.

Many IES-sponsored lighting courses were conducted in the fall of 1947, and other courses are under way for the winter and spring months of 1948. The following summary covers some of the major activities reported, covering the IES fiscal year of October 1, 1947 to September 30, 1948.

Boston, Mass.—The New England Section, IES, jointly with the Electric Institute of Boston, Inc., sponsored an eight-session course on "Fundamentals of Illumination", which began on October 7, and ended November 24, 1947. Tuition fee for Institute and IES members was $2.00, and for non-members $4.00. An "Advanced Lighting" course on practical lighting applications is scheduled for the spring of 1948.

Buffalo, N. Y.—The Western New York Section, IES, sponsored a lighting course consisting of six meetings in which the new IES Lighting Handbook was used as a basis of discussion. Sale of the handbook was tied in with this course at a special price of $5.00 to non-members, during which time 62 copies of the Handbook were purchased by registrants. No tuition fee was charged.

Chicago, Ill.—Three courses in lighting are being conducted in Chicago, sponsored jointly by the Chicago Lighting Institute, Illinois Institute of Technology and Chicago Section, IES. The first course consisted of twelve lectures, beginning October 6 and ending December 22, and six laboratory periods beginning October 9 and ending December 18, 1947. The second course consisted of twelve sessions, and was devoted to "Specialized Lighting", a discussion course. It began October 2, and ended December 18, 1947. Tuition fee for the Lighting Fundamentals course was $20.00, and for the "Specialized Lighting" course was $15.00. Enrollment was limited to 35 students for each course. The third course will be on the subject of "Lighting Design Problems", and will be given early in 1948.

Want 2 more Lifetimes?

KEYLESS CEILING RECEPTACLE — IVORY BAKELITE—250W—250V. For 3¼" and 4" round boxes. Extra ½" oversize design permits safety margin for installation. Rigid terminals; large binding head screws will take No. 12 copper or No. 10 aluminum wire. Light weight, advantage in shipping and handling. Not subject to mechanical stresses found in porcelain. Breakage reduced to minimum. Washer head screws furnished for quick mounting. Listed and Approved, Underwriters' Laboratories, Inc.

KEYLESS FIXTURE SOCKET—660W—250V. *One Piece* Ivory Bakelite. Will not *loosen* when lamp is backed out. No breakage—Easy one piece installation—holds fast. Same Price Class as Porcelain. Listed and Approved by Underwriters' Laboratories, Inc.

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Like all Slater products, they are engineered and built for adaptability to current construction needs, ease of installation, enduring service.

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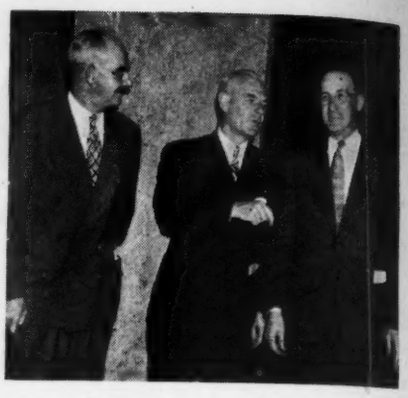


Martin C. O'Rourke (center), inspector from Waterbury, Conn., tells Bridgeport, Conn. inspector Harry C. Abercrombie (right) amusing story as Carl Turner, power engineer for The United Illuminating Company, Bridgeport, listens in. All were attending the Eastern Section, IAEI, annual meeting in Atlantic City, N. J.

Cleveland, Ohio—A course in "Advanced Lighting Practice" was given by John Huntington Polytechnic Institute, Cleveland, in cooperation with the Cleveland Section, IES, beginning October 8, and ending December 7, 1947. It consisted of eleven lectures supplemented by inspection tours. A deposit of $5.00 was required from each student and refunded at the end of the course to students having 80 percent attendance, in order to provide free instruction in accordance with the wish of John Huntington, the Founder of the school bearing his name.

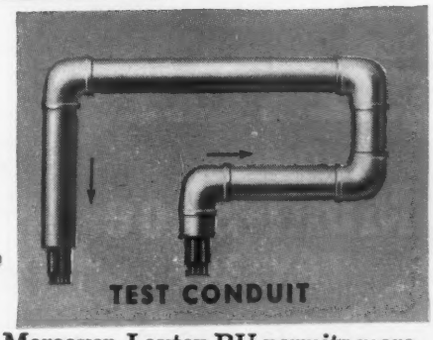
Milwaukee, Wis.—The Milwaukee Chapter, IES, began a twelve session course on "Lighting Design Problems", featuring the new IES Lighting Handbook, on November 24, 1947. Sessions are being held on every second Monday following the opening session. Registration fee was $5.00 for those having a Handbook, and $10.00 for those who did not have a Handbook, with the Handbook being given to the student at the special price of $5.00 on this basis.

New York, N. Y.—The New York Section, IES, ran an eleven weeks' course on "Fundamentals of Illumination" beginning September 29, and ending December 15, 1947. Tuition was $9.00 to members of IES or AIEE, and $18.00 to all others. Fifty students registered for this course, in which Leon T. Johnson, design engineer, Lighting Department, Public Service Electric & Gas Co., Newark, N. J. served as instructor.

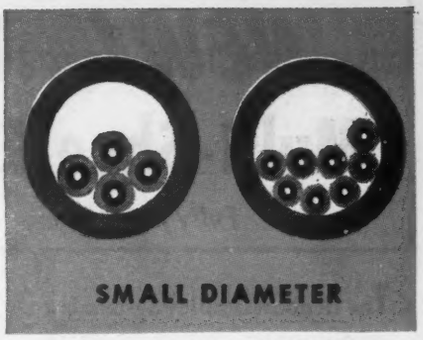
The New York Section is sponsoring an "Advanced Lighting" course in applied lighting beginning January 20, and ending March 23, 1948. Sessions are to be held weekly, with various specialists from the lighting industry serving as instructors. Tuition fee for

"It's easier to pull ...it's Laytex RU"

Mr. USRUBBY, the Wire Engineer, knows what he's talking about. Electricians find that Laytex RU, with its special new wax finish, is surpassed by no other wire in ease of pulling and handling. To be exact, only 22 to 26 pounds pull was needed to pull Laytex RU through the test conduit shown at right—as compared with 32, 40, 42, 45 and 80 pounds, respectively, for 5 other leading brands. In other words, Laytex RU is 33% to 300% easier to pull!



Moreover, Laytex RU permits more wire per conduit on rewiring jobs because it is America's smallest diameter rubber covered branch circuit wire. United States Rubber Company's unique dip method applies 90% pure rubber to the conductors, eliminating the usual bulkiness and weight.



This special method also keeps the conductors perfectly centered in the insulation, preventing thin spots. But that isn't all. The physical and electrical properties of U. S. Laytex RU far exceed those of other building wires! In tensile strength, di-electric strength, insulation resistance, and elongation, LAYTEX RU is unsurpassed. The saturated cotton fibrous cover is flame-retardant and moisture-resistant. There is no finer building wire on the market.

U. S. Laytex RU carries the label of the Underwriters' Laboratories and is listed in the National Electrical Code as an all-purpose wire. Send today for a sample plus booklet containing more details about this wire. Write Wire and Cable Department, United States Rubber Company, 1230 Avenue of the Americas, New York 20, N. Y.

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Multi-Shoe Electric Trolley
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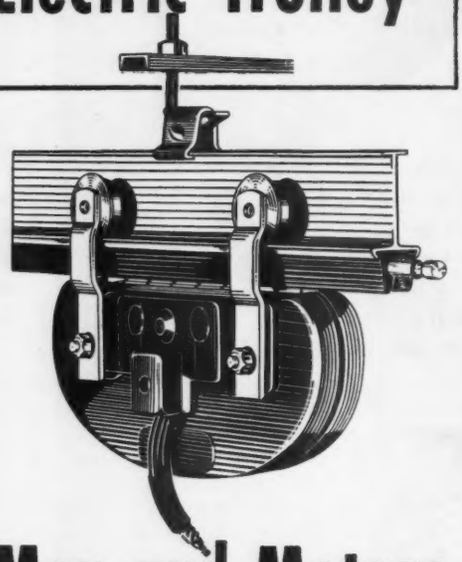

The Benbow Trolley System is a revolutionary improvement in the transmission of electric power to motors mounted on cranes, monorails, portable tools, etc. It gives trouble free performance and protection to motors and offers the greatest possible safety to operating personnel. It is not a make-shift "hooding" of the old-fashioned trolley wheel systems.

Protection for Men and Motors

Careful engineering makes the Benbow Trolley System easy to install and maintain. Patented features allow independent conductors to hang open to view but not exposed to accidental contact.

Eliminates Single-Phasing *of motors due to positive multi-shoe contact. Motors are protected from overheating, burn-outs, and starting failures.*

Non-Arcing *because of multi-shoe compression contact of five shoes, rather than the rolling or sliding action of out-moded trolley wheels.*

Conforms to *requirements of all state, national electrical and safety codes.*

Easy to Install and Maintain. *Highly flexible positioning of mounting brackets which means low-cost, fast installations. Rigid 10-ft. I-beam sections adaptable to all curves, switches and interlocks.*

The recesses through which the five shoes simultaneously contact the conductor are of such shape and size as to make even intentional contact with the line conductor difficult! Because of such remarkable safety, the system can be installed close to galleries, catwalks, ladders and elevated storage areas.

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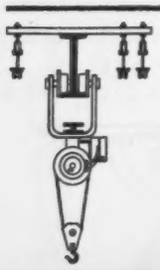

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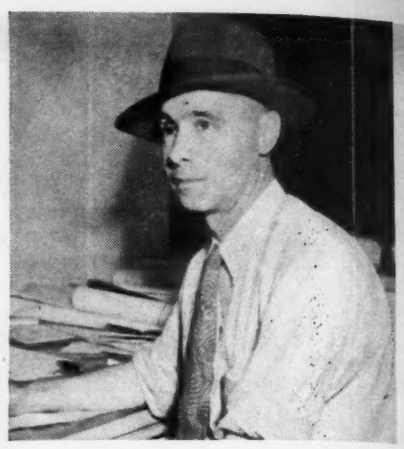

Construction superintendent H. L. Clarke, Hilscher-Clarke Electric Co., Canton, Ohio, finds contractors must do more engineering on present day jobs. Inability to secure desired equipment causes on-the-job layout changes.

this course is $9.00 for members of IES or member societies of the Technical Societies Council of New York, Inc., and $18.00 for all others.

The Residence Lighting Forum of the New York Section, IES, will conduct a five-session course on "Residential Lighting", beginning March 1, and ending March 29, 1948. This course is designed primarily for architects and decorators, and industry personnel whose primary work is in the home lighting field.

Philadelphia, Pa.—A training course in "Fundamentals of Illumination", designed specifically for electrical contractors and jobbers salesmen, was sponsored jointly by the Lighting Equipment Manufacturers Group of The Electrical Association of Philadelphia and the Philadelphia Section, IES. This ten-week course began on October 9, 1947, and sessions were held on consecutive Monday evenings. Registration totalled 186. Slide films and records of the Westinghouse Lighting Training Course were used as a summary for each session. Registration fee for the course was $10.00.

Spokane, Wash.—The Washington State Chapter, IES, sponsored a five session course on "Fundamentals of Illumination" in the fall of 1947, beginning September 12 and ending October 10. Registration was over 40 students. Another course is under consideration for the spring of 1948.

Washington, D. C.—The Capital Section, IES, has plans under way for a lighting course for electrical contractors early in the spring of 1948. It is also providing lectures in illumination for the Department of Agriculture Graduate School for their general engineering course.

Toronto, Ont., Canada—The Toronto Section, IES, is sponsoring five

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as easy as signing your name!

Renewing the solid silver contacts in a Federal NOARK Motor Starter takes no time at all! No need for tools of any kind! Simply press one end of the contact down, and it slides out of its groove without effort. Slide in a new contact to finish the job. (And, once it's in it stays in — vibration can't loosen it out!)

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W. J. Mahan, electrical inspector of New Haven, Conn., and past president, IAEI, talks with Laurence A. Dunn, merchandise manager of United Illuminating Co., also New Haven, at Eastern Section, IAEI annual meeting in Atlantic City, N. J.

monthly meetings on "Store Lighting". These five forums are designed to summarize all available data on this subject for those interested in store planning and operation. The first forum was held November 10, 1947.

The Toronto Section is also sponsoring a course in Elementary Illuminating Engineering, which will be given by the University of Toronto Extension Courses early in 1948. Preparation of the course and furnishing of instructors will be done by the Toronto Section, IES. Registration fee will be $5.00, and a minimum of 40 students will be required to make the course possible.

Vancouver, B. C., Canada—The British Columbia Chapter, IES, has conducted a five month's course, with one session monthly, on the following subjects: 1) Fundamentals of Illumination; 2) Quality and Quantity of Illumination; 3) Industrial Lighting;

Theodore E. Mullican, electrical inspector for Gov't. of District of Columbia, enjoys the Eastern Section IAEI annual meeting activities with fellow Washingtonians A. M. McKnew and Eli Miller, electrical contractors.

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CONTROL CIRCUITS
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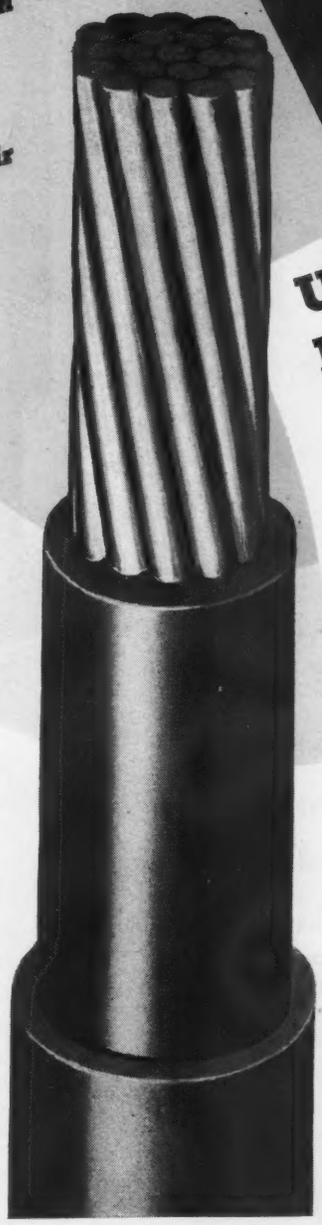

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Ro-Marine . . . a low water absorption insulation, assures high electrical stability in the presence of moisture, as well as unusually long life.

RoPrene (Neoprene) . . . as a sheath, provides exceptional resistance to oils, acids, alkalies, weather effects, industrial contamination, as well as the hazards of flame or moisture.

There are definite savings for you in this versatile, multi-purpose cable. It is designed for long life . . . is easy to handle . . . is easy to terminate. Here is a *single* cable for circuits below or above ground, indoors or out . . . without the necessity of splices. Finally, it is Underwriters' approved for 600 volts at operating temperatures up to 60° C.

Write for Specification RR-1 today. It gives you construction details, test data, and available range of sizes.

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ROME CABLE
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RCA TUBES FOR INDUSTRY

RCA-5553 (size D)
water-cooled ignition

. . . directly interchangeable with other standard types

■ Today you have a choice of more than 260 *standard* types of RCA industrial electron tubes. These tubes meet virtually every renewal requirement.

For your convenience, RCA industrial electron tubes are now available directly from RCA or from your local RCA Tube Distributor.

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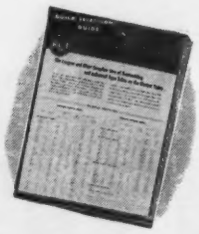
New guide includes the information you need for the quick selection of industrial renewal types. Over 260 types are listed. Ask for Bulletin 2F403. RCA, Commercial Engineering, Section AT77, Harrison, N. J.



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New York Chapter IAEI active members Dominick F. Paduano and A. Morra, electrical inspectors for Dept. Water Supply, Gas & Electricity, City of New York, attended the Eastern Section 23rd annual meeting held in Atlantic City, N. J.

4) Office Lighting; and 5) Store Lighting. Average attendance was 25, and enrollment was free.

The above activity in lighting education is in addition to the normal activities of Sections and Chapters of the Illuminating Engineering Society, which are the holding of meetings of both a technical and popular nature, usually on a monthly basis during the fall, winter and spring months. Many of the larger Sections also hold monthly Study Club meetings, or forums, where technical phases of lighting are discussed. Home lighting in all its phases is also studied and discussed separately by Residence Lighting Forums sponsored by some of the larger metropolitan Sections.

Increase in Construction

Investments in construction amounting to $793,286,000 in October in the thirty-seven states east of the Rocky Mountains pushed the chart lines upward to a level 22 per cent higher than the volume shown for last month and 38 per cent higher than in October of last year, to bring the cumulative total for the first ten months of 1947 to $6,419,397,000, almost even with that reported for the corresponding period of last year, it was made known recently by F. W. Dodge Corporation, a fact-finding organization for the construction industry.

The greatest October gains compared with September were shown for Texas, up 85 per cent; southern Ohio and Kentucky, up 67 per cent; western Missouri, Kansas, Nebraska and Oklahoma, up 54 per cent; upstate New

AUSTIN Presents the greatest improvement in TIME SWITCH DESIGN in many years

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- Hole for meter seal.
- Clear plastic window to check operation without removing cover.
- Beautiful modern streamlined steel case in colorful blue and yellow lacquered finish — size 7" high, 4⅜" wide, 3⅝" deep.
- Attractive etched exterior name showing Catalog No. and complete switch rating.

Heavy 16-gauge base plate, 10% heavier than usual, provides rigid strong base support. No chance to bind operating parts.

Hand Trip-Lever at top of switch, away from terminals.

Standard Models equipped with two tripper dial (one ON and one OFF.)

Four tripper dial can be furnished when specified at no extra cost.

Positive Toggle Switch Action. Roller bearing against trippers provides longer life and trouble-free movement.

Three supporting holes in back. Top has key-hole slot for easy mounting.

Terminals marked for easy wiring.

Combination ½" and ¾" knockouts, one in each side, back and bottom conveniently located.

Only one screw holds cover rigidly in place. To remove, simply loosen and slide off cover.

Large 3" dial with numerals easy to read and set.

Time Setting quickly made by loosening nut.

Large size terminal screws provide good electrical and permanent connection — polarized.

All terminals below plate for greater safety.

Plenty of room for all wiring.

ALL AUSTIN PRODUCTS SOLD EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

Slow speed, self-starting, self-lubricating, synchronous heavy-duty motor. Motor completely enclosed, protected from dust and dirt. Babbitt bearings.

Heavy Torque Motor, will operate switch in any position.

Motor window for checking operation.

Heavier phosphor bronze spring-blade provides greater contact pressures, insuring longer life.

Heavy gauge brass terminal.

Large electrical clearances.

Gear box riveted to top plate to prevent tampering.

All gears enclosed in dust-tight gear box, graphite oil lubrication at time of assembly.

Large silver-faced contacts assures long life.

Top contact has convex face, giving positive contact for wiping action at all times.

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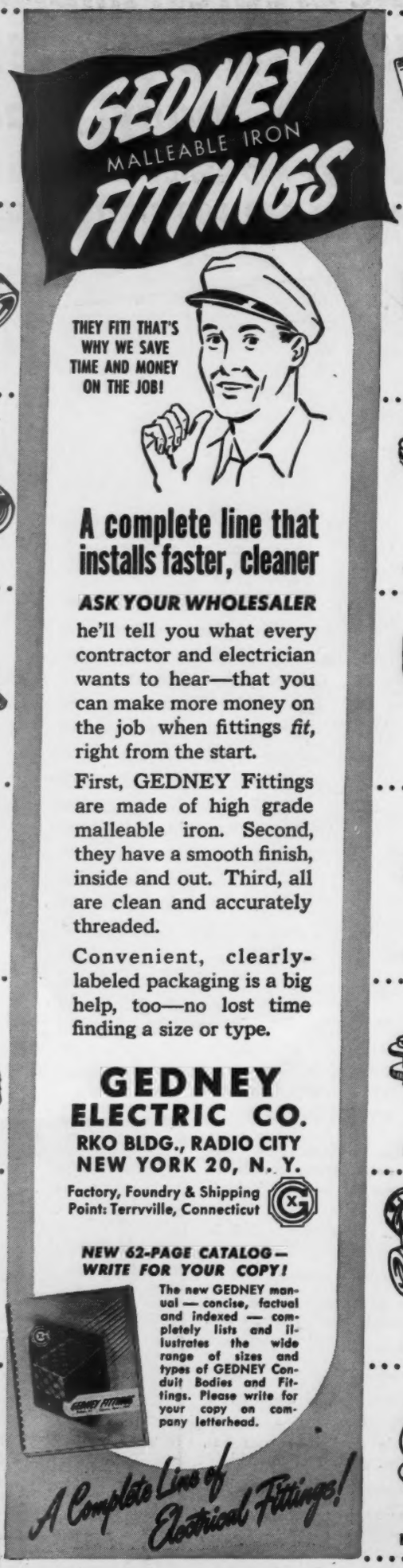
COMBINATION COUPLINGS
EMT SERVICE CAPS
THREADED BODIES
GROUND FITTINGS
SQUEEZE CONNECTORS
EMT 90° ELBOW CONNECTORS
REVERSIBLE CLAMP CONNECTORS
ANGLE CONDUIT INSULETS
GEDNEY MALLEABLE IRON FITTINGS
THEY FIT! THAT'S WHY WE SAVE TIME AND MONEY ON THE JOB!
A complete line that installs faster, cleaner
ASK YOUR WHOLESALER
he'll tell you what every contractor and electrician wants to hear—that you can make more money on the job when fittings fit, right from the start.
First, GEDNEY Fittings are made of high grade malleable iron. Second, they have a smooth finish, inside and out. Third, all are clean and accurately threaded.
Convenient, clearly-labeled packaging is a big help, too—no lost time finding a size or type.
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Factory, Foundry & Shipping Point: Terryville, Connecticut
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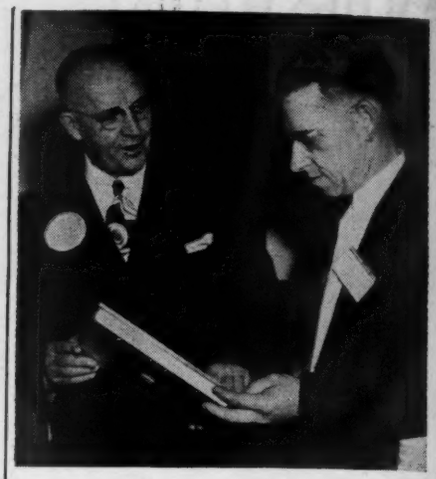
EMT BODIES
WATERTIGHT BOX CONNECTORS



Calvin M. Church (right) electrical contractor of Grayling, Michigan, learns about light control features of new Polystyrene lens from L. A. Kline of The Miller Company.

York, 51 per cent and New England, 41 per cent.

Gains in October construction contract volume over September were reported for all other areas east of the Rocky Mountains except western Pennsylvania and West Virginia, down 12 per cent; the northern and eastern areas of Ohio, down 4 per cent; Minnesota and the Dakotas, down 1 per cent.

The strongest advances were in residential building contracts, October gains of 30 per cent over September and 49 per cent over October of last year being reported, with the cumulative volume of the first ten months of the year being 3 per cent below that reported for last year.

Last month nonresidential contracts totaled 16 per cent more than in September, and 23 per cent more than in October of last year, the cumulative ten-month total being 7 per cent less than that shown for the comparable period of 1946, while heavy engineering volume last month was 17 per cent greater than in September and 47 per cent higher than in October last year, with the ten-month total up 12 per cent.

Various governmental agencies awarded contracts amounting to $208,947,000 in the eastern states last month, to bring the cumulative total of contracts let for projects classified as publicly owned this year to $1,865,363,000, which is 29 per cent of all construction contracts awarded.

Storck Heads Quaker City NISA

W. E. Storck, Watts & Stern, Inc., Philadelphia, was elected president of the Quaker City Chapter of the National Industrial Service Association at

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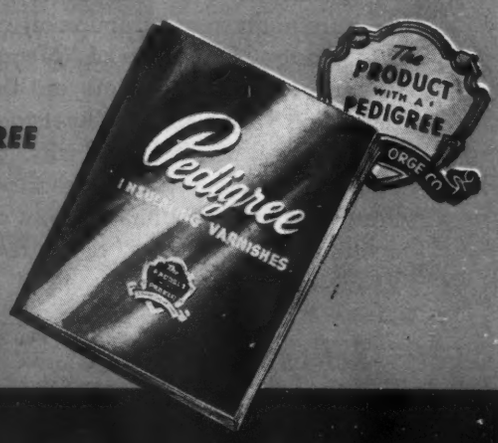

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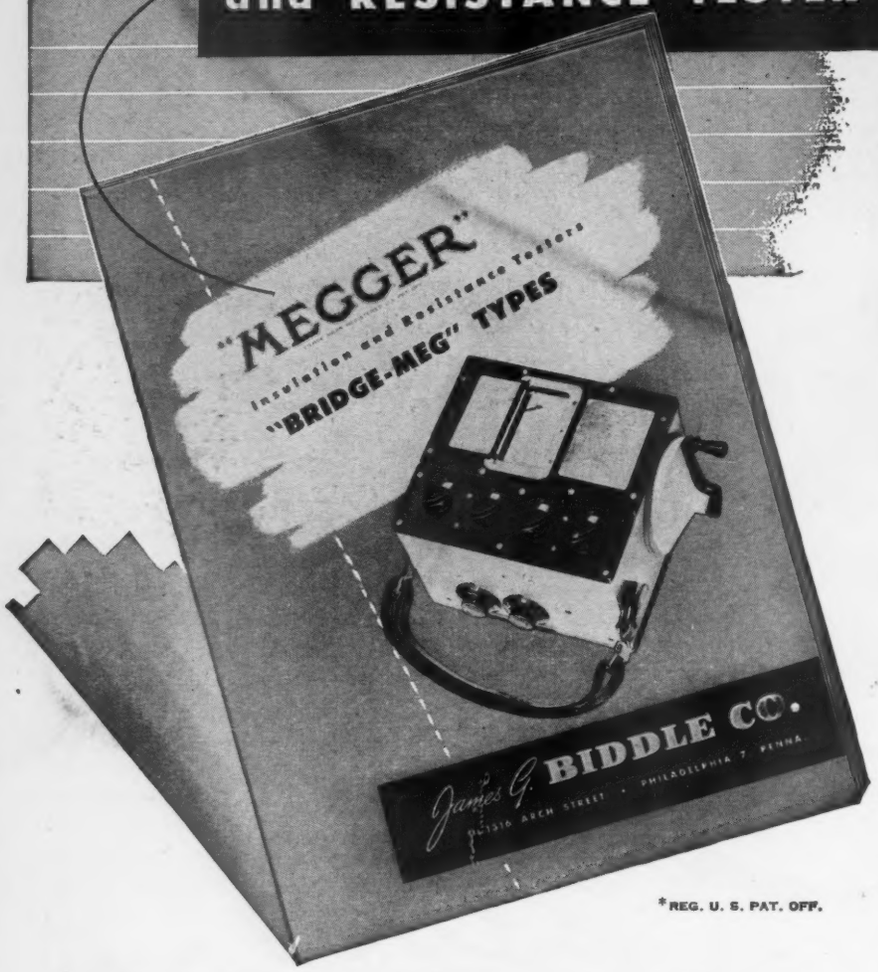
Bulletin of the Month

"BRIDGE-MEG" INSULATION and RESISTANCE TESTER



*REG. U. S. PAT. OFF.

DESIGNED and built to provide maintenance men with practically everything necessary for electrical resistance measurements from a fraction of an ohm up to 1000 megohms, the "Bridge-Meg" type of "Megger"* instrument combines in one compact, *portable* unit the facilities of a "Megger" Insulation Tester and a Wheatstone Bridge.

You'll find the "how and why" of the "Bridge-Meg" Insulation and Resistance Tester described fully within the profusely illustrated pages of this Bulletin of the Month. *Your* copy is waiting. No obligation, of course. Send *today* for Bulletin 21-60—EC.

JAMES G. BIDDLE CO.

ELECTRICAL & SCIENTIFIC INSTRUMENTS

1316 ARCH STREET • PHILADELPHIA 7, PENNA.

B. H. Allen, (left), manager, Adequate Wiring Bureau, Electrical Association of Detroit, tells E. J. McGinnis, Cincinnati Electrical Association, about residential wiring activities in the motor city.

a recent formal organization meeting of that group. Other officers elected included: Vice-President—C. R. Durand, H. N. Crowder, Jr. Co., Allentown; treasurer—W. M. Hendrickson, W. M. Hendrickson & Son, Philadelphia; secretary—J. G. Persson, Electric Apparatus Repair Co., Philadephia.

In addition to the Quaker City group, the NISA Board of Directors have granted charters to the following new chapters: King Coal, Louisville, Cleveland, Seattle, Portland, Los Angeles, San Diego, Columbus.

Birmingham Officers Elected

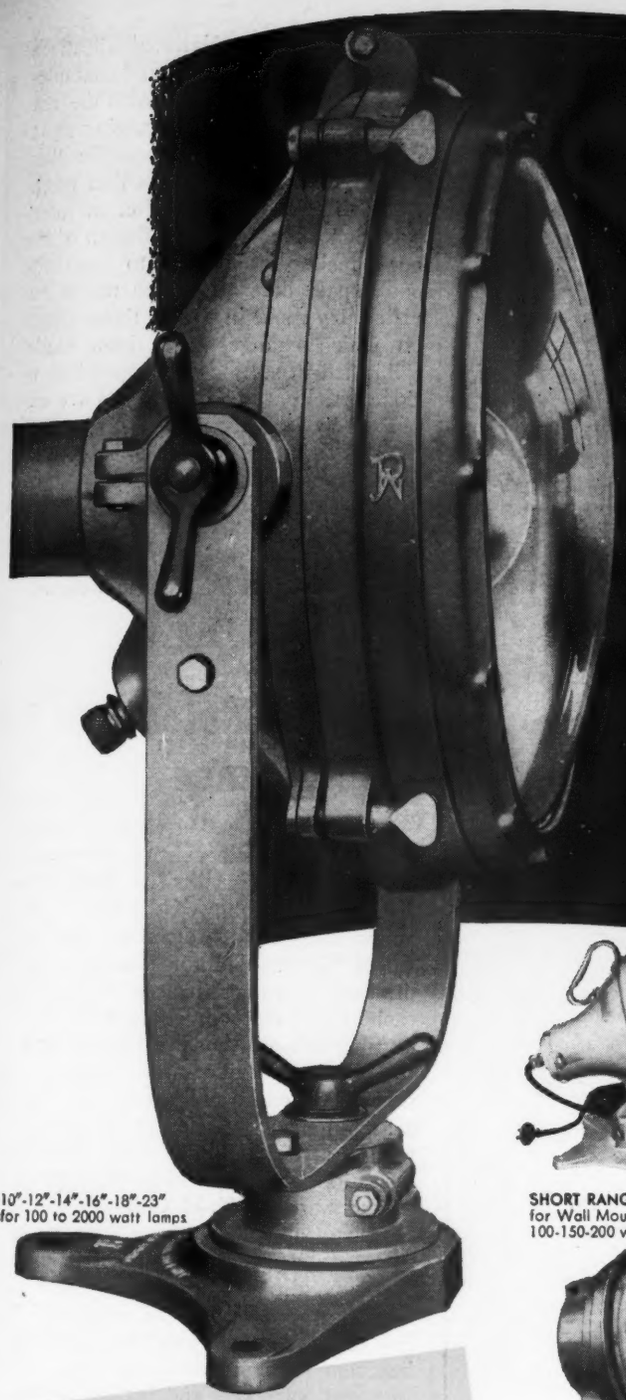
The Birmingham Chapter of National Association of Electrical Contractors plan an active campaign on adequate wiring during the remainder of the year.

New officers of the chapter include George Juneman, Juneman Electric Co., president, succeeding C. L. Teal of Knight Electric Co.; L. E. Lacey, Lacey Electric Co., vice-president; Thomas Woodford, Woodford Electric Co., treasurer; and Ben Scarbrough, secretary-manager.

Book Reviews—

Code Reference

Written as a ready reference for contractors, inspectors, electricians, maintenance men and engineers, "Electrical Code Diagrams" is a loose-leaf book

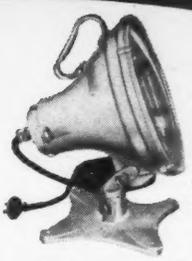


10"-12"-14"-16"-18"-23"
for 100 to 2000 watt lamps

Specify-

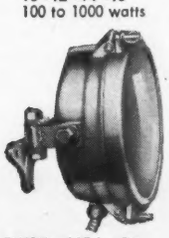
PYLE-NATIONAL FLOODLIGHTS

for Permanent Heavy-Duty Floodlighting



SHORT RANGE—10"-12"
for Wall Mounting
100-150-200 watts

PORTABLE
10"-12"-14"-16"
100 to 1000 watts



FLUSH—10" for Pit or
Subway Wall or Ceiling
100-150-200 watts

Dependable Floodlighting with Minimum Maintenance

Pyle-National floodlight equipment is designed and constructed to withstand the most severe operating conditions. Complete range of types and sizes are available.

RUGGED cast aluminum housings with tight sealing doors and door glass joints—positively dust proof and moisture proof—give maximum protection to reflectors and lamps and reduce cleaning and other maintenance to an absolute minimum.

STRONG, galvanized cast iron bases and brackets of many types are provided for simple mounting and accurate adjustment in all locations.

ADVANCED DESIGN of the carefully molded and highly polished reflectors and lenses insure the highest optical efficiency—thoroughly annealed for maximum toughness.

Write for catalog 2100 giving complete information.

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"KLEIN-LINE" BELT
New design with "Klein Kord" Sliding Trace that allows movement of approximately 6 inches in either direction. Reduces chafing and safety strap wear. Comfortable latigo leather cushion. All sizes.

"KLEIN-KORD" BELT
Made of "Klein-Kord," the material made famous by Klein Red Center Safety Straps. Wide, comfortable fabric cushion. All sizes.

★ To the lineman a fine tool belt is more than a necessity—it is a proud possession that assures safety, comfort and convenience—is essential to efficient work.

Klein Tool Belts—favorites among linemen—are made in a range of styles and sizes to suit individual preferences and requirements. Advantages of Klein Belts include tested "Dee" rings drop forged from the finest steel . . . hand-set rivets of solid copper . . . lock stitched sewing with hot waxed thread . . . convenient tool loops . . . plier pocket, tape thong and knife snap.

Illustrated here are two recent additions to the complete line of quality Klein Tool Belts—the "KLEIN-LINE" Belt with the sliding trace and the "KLEIN-KORD" Belt made of multiple plies of long staple cotton vulcanized in rubber.

To assure the last word in comfort, convenience and safety be sure to specify Klein Tool Belts.

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Foreign Distributor: International Standard Electric Corp., New York

A copy of the Klein Pocket Tool Guide, showing the Klein line and containing valuable tool information, will be sent on request.

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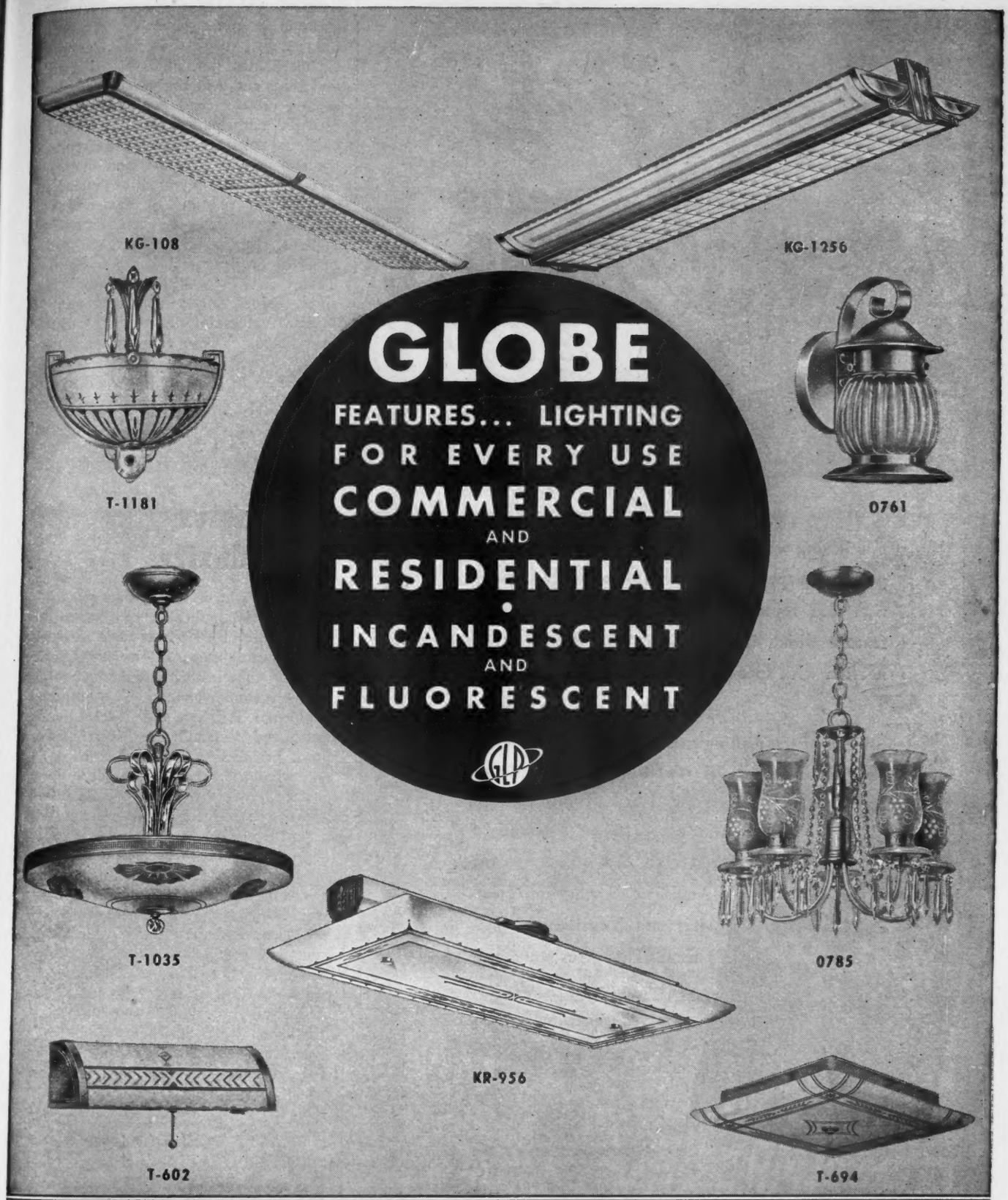
that explains the National Electrical Code with text, diagrams and examples. Background material explains the reasons for establishing or changing existing rules. Diagrams and specific illustrations explain all rulings that might cause differences of opinion in interpretation. The loose-leaf design of the book makes it possible to keep the book up to date after each major revision by replacing only those pages on which changes have been made. Published in sections corresponding to Code articles, the requirements are explained by B. Z. Segall. The first sections of the new book to be made available cover articles 200, 210 and 220 on branch circuits and feeders. Over 150 diagrams are contained in these sections which are priced at $3.00. Code Data Publishers, Post Office Box 247, Atlanta 1, Georgia.

Electric Motor Maintenance

A practical, detailed reference book for inspectors, supervisors, mechanics and students describes in detail procedures to be followed for inspecting, maintaining and repairing motors. Titled "Electric Motor Maintenance," the book discusses the construction of each type of motor in general use, testing methods and tools to be employed. The book is divided into three parts for clarity, one dealing with mechanical maintenance of motors; the second with electrical; and the third with the operation and application of motors. The author, W. W. McCullough of the District Manufacturing and Repair Department, Westinghouse Electric Corporation, also gives a full account of cleaning and drying of motors. A few of the many topics discussed are bearings, commutators, air gap adjustment, varnishes and insulating materials, induction and d-c motors, motor-generator sets and electric couplings. The book has 126 pages, sized 5⅝ by 8⅝ inches. It sells for $2.00 and is published by John Wiley and Sons, Inc., New York City.

Engineering Handbook

A compact and complete "Handbook of Engineering" is Waterbury's revised encyclopedia of mathematics and engineering data. Contained in this 386-page, 3 by 5⅝ inch book, are sections devoted to electrical engineering, illuminating engineering, radio and



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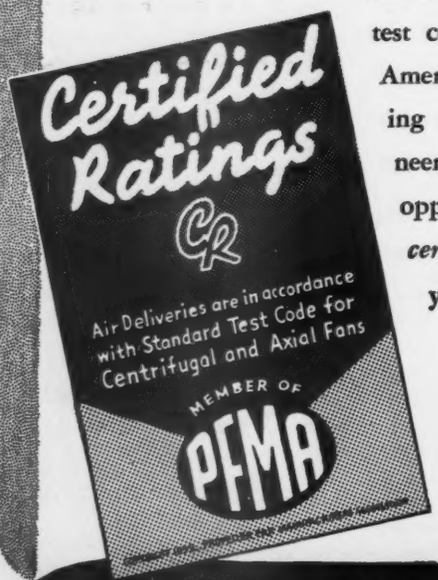
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electronics, algebra, trigonometry, mensuration, analytic geometry, differential calculus, integral calculus, theoretical mechanics, mechanics of materials and fluids and heat engineering. In the section on electrical engineering, the essential mathematical formulas for circuits and apparatus include a-c circuits, transformers, generators and motors. The section on illumination includes calculations relating to modern extended light sources, such as tubes, ribbons, rectangular and circular patterns of brightness in plane surfaces. Tables include logarithms of numbers, sines, cosines, tangents and cotangents. Natural values for these functions are also listed. Vest-pocket in size, the book is a ready reference for on-the-job use. $2.50 in price, it is published by John Wiley and Sons, Inc., New York City.

Electronics For Industry

For one who is chiefly concerned in the industrial application of electronics, "Electronics for Industry" is a comprehensive reference book which gives the basic theories behind all commonly-used electronic devices. The authors, Waldemar T. Bendz and Charles Scarlott of the Westinghouse Electric Corporation, clearly know what to omit and what to include. The result is a smooth-flowing treatise that is comprehensive without overpowering the practical engineer with design details and ultra-technical research data. Topics included in the discussions are the electronic rectifier and oscillator, electronic timers, the fluorescent lamp and the electron microscope. A concise summary at the end of each chapter presents facts in an easily-utilized reference. Illustrations, both diagrammatic and photographic, are numerous. Published by John Wiley and Sons, Inc., New York City, the book contains 501 pages measuring 5⅝ by 8⅝ inches. $5.00 per copy.

Control of Electric Motors

Motor controls range from complicated controls used for a newspaper press to a simple starter for a small fan. The many motor controls between these extremes are discussed in "Control of Electric Motors", a book written by Paisley B. Harwood, man-

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Multicoupler Antenna System

Improved ALL-WAVE

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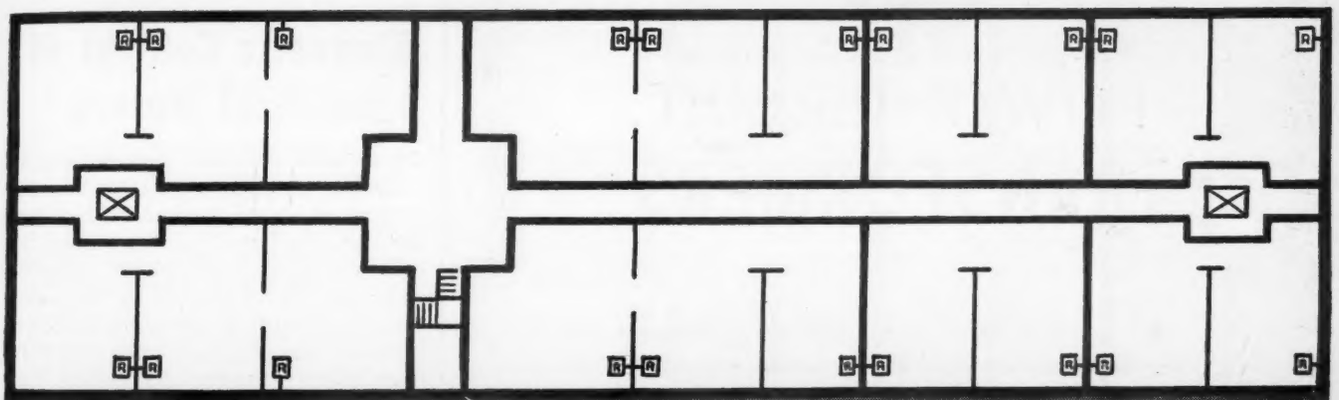
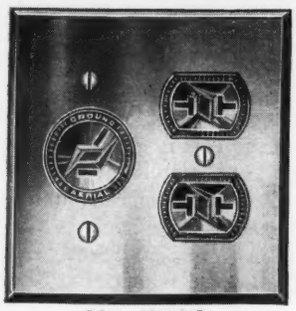
• Standard Broadcast • Short Wave



1 Aerial for Plurality of Radio Sets



No. 3120

2 Gang Unit

1 Radio and 2 Power Outlets Complete,—consisting of Two Gang Multicoupler Unit, 2 Gang Cover with Divider Plate, No. 1913 Duplex Convenience Outlet, No. 2149 Radio Outlet, GH Cap, Multicoupler, 2 Gang .040" Brass Plate . . Use standard 4" square box (not included).

No. 3124

1 Gang Unit

Radio Outlet Only

Complete,—consisting of Single Radio Outlet Multicoupler, No. 2149 Radio Outlet, GH Cap, Multicoupler, 1 Gang .040" Brass Plate . . . Standard switch or outlet box can be used (box not included).

Up to 20 radio outlets may be serviced from *one* antenna where this multiple receiving system is installed. The system brings to each radio set complete "freedom of the air" in getting any desired broadcast, regardless of what programs other sets may be tuned to at the same time. It brings in FM, standard broadcast and short waves with maximum of volume and minimum interference.

Multicoupler-Antenna System is not only the *most adaptable* to the whole range of radio conditions; it's the least expensive and most easily installed of any multiple receiving system. For apartment houses, private homes or hotels, hospitals and dormitories, this system economically *completes* your up-to-date radio facilities.

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THE most economical way of providing low voltage circuits for the lighting and operating of machine tools is to run a branch line from the power line, using a transformer to step down the voltage.

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ager of engineering, Cutler-Hammer, Inc., providing a general source of information for those working with electric motors. Characteristics of various motors are briefly described with relation to control purposes. The design, construction and operating characteristics of a number of controllers and control devices are discussed in detail, as are problems frequently encountered. Problems include those of motor acceleration, dynamic braking and resistor design. This second edition contains many new tables giving ratings for motors and controllers. It also includes chapters suggested by readers of the first edition, such as synchronous motor and variable-voltage control. The arrangement has been radically changed to improve the usefulness to the user. Published by John Wiley and Sons, Inc., New York City, the book is priced at $5.50 and contains 479 pages sized 5⅝ by 8⅝ inches.

Magnetic Control of Industrial Motors

Characteristics of control devices, functions of commonly-used control circuits and electric motor performance are thoroughly covered in "Magnetic Control of Industrial Motors" by G. W. Heumann of the General Electric Company's Control Engineering Division. The author places editorial stress on the user's requirements rather than upon the details required by the design engineer. Instead of speaking from the standpoint of a device, a circuit or a mechanical arrangement of parts, Mr. Heumann talks in terms of what control equipment can accomplish, what is required of a particular drive system, and what performance can be expected of various types of motors. The book is written by an experienced engineer who presents the latest available information on subjects ranging from a-c hoist controls to amplidyne control. Measuring 5¾ by 9 inches and containing 589 pages, the book is published by John Wiley and Sons, Inc., New York City, and is priced at $7.50 per copy.

Heat Pumps

With a wide background in both operation and design, three authorities from the American Gas and Electric Service Corporation (Philip Sporn, President; E. R. Ambrose, Air Conditioning Engineer; and Theodore Baumeister, Consulting Engineer) have collaborated to write a concise, practi-

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● THE SHADE OF DIFFERENCE between good lighting and Borderline Vision can definitely affect the rate of production in your plant. Frequently Borderline Vision looks good—but actually isn't good enough to permit maximum efficiency. With Wheeler Skilled Lighting, you get light that's right.

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For 2 or 3 40-watt, or 2 100-watt lamps. Available with open end or closed end porcelain enameled reflectors. Broad wiring channel with accessible enclosed ballast. For individual or continuous runs.

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Maximum lighting efficiency indoors or out. Expertly designed. Ruggedly built. Vitreous enamel only. 75 to 1500 watts.

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"The GREENLEE is a very good, fast, and efficient electrician's tool. Through its use, a savings of 30% in labor hours is realized. In addition, the GREENLEE brings about a 30% savings on fittings and manufactured bends."

Savings like these in labor and materials are extremely important today...they mean faster completion of jobs, better opportunity to take on more contracts, step up volume of installations.

For, even a beginner can take a GREENLEE Bender and in *just a few minutes* produce smooth, precise bends in pipe up to 4½", rigid and *thin-wall* conduit, tubing, bus-bars.

The GREENLEE is hydraulic...one-man-operated, compact, portable, easy to set up. Lets you bend conduit where and when needed. Get complete facts today. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 1741 Columbia Avenue, Rockford, Ill.

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Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pushers

cal book on Heat Pumps. The purpose is to present a reasonable technical treatment of the numerous problems encountered in the attempt to adapt the heat pump, not only to building heating and cooling, but also to the important applications in the industrial field for the evaporation and purification of liquids, for drying of solids, and for the simultaneous chilling and heating of process fluids. Only those aspects of the performance and design of these equipments are considered which will assist in the development and assembly of a good heat-pump installation.

The subject is presented by successive consideration of the thermodynamic principles involved, equipment design, specification and selection, maintenance, operation and installation and economic problems. The book is pocket size, contains numerous photographs, charts, installation diagrams and formulas. Price, $3.75. Published by John Wiley and Sons, Inc., N. Y.

Dates Ahead

National Materials Handling Exposition—Public Auditorium, Cleveland, Ohio, January 12-16.

Fifth All Industry Refrigeration and Air Conditioning Exposition—Public Auditorium, Cleveland, Ohio, January 26-29.

American Institute of Electrical Engineers—Winter general meeting, William Penn Hotel, Pittsburgh, Pa., January 26-30.

8th International Heating and Ventilating Exposition—Air Conditioning Exposition, Grand Central Palace, New York, N. Y., February 2-6.

Electric League of Western Pennsylvania—Commercial and Industrial Sections, Planned Lighting Exposition and Conferences, William Penn Hotel, March 1-4.

North Central Electrical Industries—All-Industry Convention and Trade Show, St. Paul, Minn., March 1-4.

National Electrical Manufacturers Association—Winter Convention, Edgewater Beach Hotel, Chicago, Ill., March 14-18.

National Association of Corrosion Engineers—Fourth annual Conference and Exhibition, Jefferson Hotel, St. Louis, Mo., April 5-8.

Midwest Power Conference—Tenth annual conference, sponsored by Illinois Institute of Technology, Sheraton Hotel, Chicago, Ill., April 7-9.

San Francisco Real Estate Board and Associated Home Builders of San Francisco, Inc.—Home Show, Civic Auditorium, San Francisco, Calif., April 7-14.

Home Builders Council of New York, New Jersey and Connecticut—Annual Home Show, Grand Central Palace, New York, N. Y., April 17-24.

National Industrial Service Association—Annual convention, Hotel William Penn, Pittsburgh, Pa., April 26-29.

Chamber of Commerce—Annual meeting, Washington, D. C., April 27-29.

National Electrical Wholesalers Association—Annual convention, Statler Hotel, Buffalo, N. Y. First week in May.

Edison Electric Institute—Annual Engineering meetings, Edgewater Beach Hotel, Chicago, Ill., May 3-5.

National Fire Protection Assn.—Annual meeting, Statler Hotel, Washington, D. C., May 10-13.

Edison Electric Institute—Annual convention, Atlantic City, N. J., June 2-4.

Second International Store Modernization Show—Grand Central Palace, New York, N. Y., July 6-10.

Illuminating Engineering Society—National Technical Conference, Boston, Mass., September 20-24.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., November 8-13.

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Safe Service Connections

Smooth, rounded surfaces protect wire insulation. Deep, sharp screw threads assure easy and firm installation. Non-shrinking metal alloy keeps screws permanently fastened to insulators. Special galvanizing process protects all-steel screws with smooth, even coating. No rust streaks on sides of buildings. These dry process wireholders available in sufficient styles and sizes to meet all requirements. Wet process porcelain supplied on special order.

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or the trademark on every porcelain product you buy. That's your assurance of the best in porcelain.

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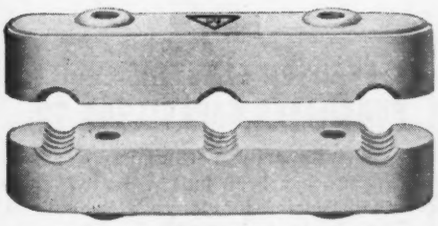
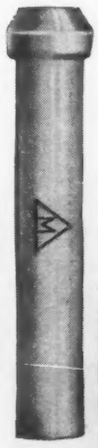
TUBES—Glazed, unglazed, split, floor, split floor, headless, curved, crossover split, and crossover. Uniform inside and outside diameters. Sizes ½ to 48" long, 5/16 to 3" diameter.



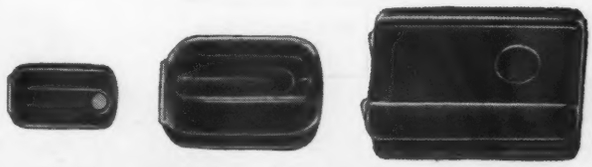


CLEATS

Standard cleats of all sizes and types.

ILLINOIS GUY STRAIN INSULATORS

For best results use Guy Strain Insulators made by Illinois. These insulators are manufactured under rigid production control standards, from the careful selection of materials, through all steps leading to a top quality finished product. Uniform firing at constant temperatures eliminates internal stress. Available from large stocks of standard sizes.



ILLINOIS
ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS

FULLMAN Latrobe PRODUCTS

FLOOR BOXES WIRING SPECIALTIES

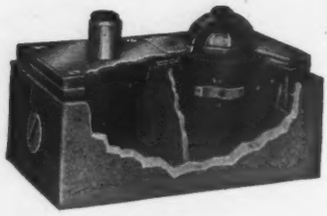
"LATROBE" = "SERVICE"

Dependable, trouble-free service has always been the chief appeal of "Latrobe" Floor Boxes and Wiring Specialties.

Easy and quick to install "Latrobe" products serve long and well.

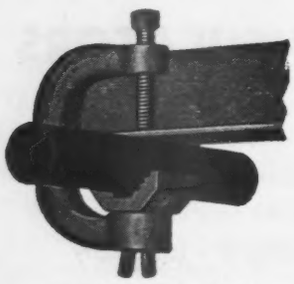
No. 284 Nozzle with No. 200 Cover Plate

Duplex Receptacle Nozzle with ½" Brass pipe extension. We furnish many types of Nozzles for use with "Latrobe" Watertight Floor Outlets.



No. 252-R Floor Box

Two-gang Floor Box with No. 208 Receptacle in one section. One Cover Plate with ½", the other with 2" Flush Brass Plugs.



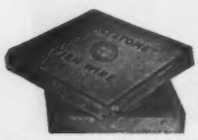
No. 471 "Latrobe" Pipe or Conduit Hanger

High quality and sure performer yet very economical for hanging pipe or conduit to steel beams. Takes pipe ½", ¾" and 1".

No. 110 "Latrobe" Watertight Floor Box

Approved by Underwriters Laboratory. Iron box body. 3½" round brass cover plate. No. 208 fits tapered opening in top of box body.

Sold Only Through Wholesalers



"Keystone" Fish Wire

High quality flat steel wire. Ten sizes, in coils from 100 feet up.

"Bull Dog" Insulator Supports

Malleable iron of high tensile strength for fastening porcelain or glass insulators to exposed steel framework. Four sizes.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

Manufacturers News

G-E APPOINTMENTS

C. C. Walker of Boston has been elected a commercial vice president of the General Electric Company by the board of directors. Mr. Walker will assume responsibility for customer relations in the New England territory, with headquarters in

C. C. WALKER

Boston. He succeeds T. S. Knight, G-E commercial vice president, who retired December 31, after 44 years of service with the company.

Four new appointments in the G-E apparatus department have been announced. W. V. O'Brien has been named assistant general manager of sales; R. M. Darrin of New York, manager of central station divisions, succeeding Mr. O'Brien; J. C. Miller, assistant to the manager of sales; and H. P. Bish, manager of Aircraft, Federal and Marine Divisions.

A. Martin, L. H. Means, E. S. McKay, and D. J. Sullivan have been appointed assistants to W. V. Merrihue, manager of employee and community relations in the G-E apparatus department. Mr. Martin has been named assistant to the manager, in charge of employee relations; Mr. Means, in charge of labor relations; Mr. McKay, in charge of community relations; and Mr. Sullivan, in charge of opinion research and program development.

H. R. McKean has been appointed general superintendent of G-E's transformer and allied product divisions; J. B. Dunn, production manager; F. F. Brand, manager of engineering; and H. F. McRell, manager of sales.

JEFFERSON ELECTRIC PURCHASES CAPACITRON CO.

The Capacitron Company, Inc. of Chicago has been purchased by Jefferson Electric Company, Bellwood, Ill. The chief products of Capacitron include oil-filled and electrolytic condensers; a-c motor starting capacitors; and Ballastrons.

According to A. E. Tregenza, execu-

8 GOOD REASONS WHY!!!

...Wire insulated with GEON for manufacturing, domestic, industrial, and utilities wiring...

Excellent electrical properties

Thin coating of insulation

More conductors in a given space

Ease of handling

Easy stripping

Light weight

Resistance to ozone, wear, sunlight, water, chemicals, and most other normally destructive factors

14 colors including NEMA standards

Be sure to specify wire or cable insulated with GEON in order to get *all* these advantages. Or, for information regarding special applications please write Department H-1, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

Geon
Polyvinyl Materials
A TRADE MARK OF B. F. GOODRICH CHEMICAL COMPANY

Commutators!

FOR PROMPT SERVICE CONTACT YOUR NEAREST DISTRIBUTOR

— • —

DISTRIBUTORS CARRYING STOCK

— • —

INSULATION & WIRES INC.
3435 Choteau Ave.
St. Louis 3, Missouri
25 W. Broadway
New York 7, N. Y.
30 Trowbridge Ave.
Detroit 2, Michigan
1040 Tremont St.
Boston 2, Mass.
450 Bishop St. N. W.
Atlanta, Georgia
1111 Live Oak St.
Houston 3, Texas

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TRI-STATE SUPPLY CORPORATION
318 Occidental Ave.
Seattle, Washington
544 S. San Pedro St.
Los Angeles, California
554 Bryant St.
San Francisco, Calif.

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Sales by Representatives only

MANUFACTURERS SPECIALTIES, INC.
312 E. Wisconsin Ave.
Milwaukee 2, Wis.

A. J. ELLIS CO.
20 E. Jackson Blvd.
Chicago 4, Illinois

AVAILABLE
FROM STOCK...

REPAIR SHOPS...NOTE

A FACTOR OF PARAMOUNT IMPORTANCE WHEN PROMPT SERVICE IS ESSENTIAL

ALL TYPES
ALL SIZES
TO MEET YOUR REQUIREMENTS

SEND IN OLD CORES OF BOLT OR NUT TYPE CONSTRUCTION FOR REFILL

SPECIAL SIZES CAN BE MADE FROM YOUR SAMPLES OR SKETCHES

NEW CATALOG!
AVAILABLE
SEND FOR YOUR COPY
List Complete Dimensions of All Types of Commutators

THE KIRKWOOD COMMUTATOR C
1345 CARNEGIE AVE., CLEVELAND 15, OHIO

The KIRKWOOD COMMUTATOR Co.
1345 CARNEGIE AVENUE • CLEVELAND 15, OHIO

tive vice president of Jefferson, plans have been made to continue the production of condensers and capacitors in the present Capacitron Company plant, enlarging and improving facilities as required.

J. F. DREIER NAMED SALES MANAGER OF HART

John F. Dreier of Meriden, former assistant sales manager, has been appointed sales manager of the Hart

J. F. DREIER

Manufacturing Company, Hartford, Conn., to succeed the late Frank W. Watts.

He is a graduate of Bliss Engineering School, Washington, D. C. and for the past 15 years has been active in sales and manufacturing work within the electrical industry.

E. E. DeMARSH APPOINTED SALES MANAGER OF BURNDY

Following his recent election to the board of directors of the company, Eric E. DeMarsh has been appointed

E. E. DeMARSH

sales manager for Burndy Engineering Company, Inc., New York City and Vernon, Calif.

Mr. DeMarsh joined Burndy in 1936 as chief field engineer and in 1939 was made assistant director of company sales, domestic and foreign. He is a graduate of Rensselaer Polytechnic Institute.

IN DUTCH BRAND

You Have a Famous Family of Insulating Tapes

DUTCH BRAND FRICTION TAPE

The recognized leader in the Friction Tape field. By actual count, preferred by over 80% of electrical contractors. *Sticks tight, will not ravel, tears straight, insulates perfectly.* Costs no more than ordinary friction tapes. Comes in four handy sizes designated as No. 1, 2, 4 and 8.

DUTCH BRAND "JUMBO" SHOP PACKAGE

A high quality friction tape available in special tamper-proof "JUMBO" package containing 10 full 68 foot rolls of genuine DUTCH BRAND FRICTION TAPE. This size package is ideal for electrical contractors, municipal power and light companies and large industrial users.

DUTCH BRAND RUBBER TAPE

This rubber tape has all of the qualities necessary for a better tape. *High dielectric strength, long life, freedom from corrosive chemicals, immediate fusing, and surplus stretchability* (for ease of application — it winds perfectly). DUTCH BRAND RUBBER TAPE is carefully manufactured of only the finest materials, it amply exceeds government and ASTM specifications.

DUTCH BRAND "HIPPO" SHOP PACKAGE

A special shop package designed to extend the benefits of the "JUMBO" package to volume buyers of rubber tape. The "HIPPO" shop package contains ten No. 8 rolls of high quality DUTCH BRAND RUBBER TAPE identical, except for package, to the tape furnished in individual packages as mentioned above.

There are also specialized insulating tapes produced by DUTCH BRAND for special uses—such as Electro Coil Tape and Glass-Fiber Tape.

VAN CLEEF BROS. INC.

Manufacturers of the Internationally Known
DUTCH BRAND Rubber and Chemical Products
Chicago 19, Illinois

GENERATE YOUR OWN

ELECTRICITY

FOR ANY PURPOSE—AT LOW COST

with a

Universal ELECTRIC PLANT

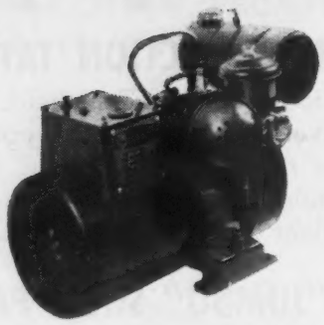
ECONOMICAL electric power is yours with a Universal. In initial cost, operation and maintenance—these *properly* engineered electric plants are lowest in cost.

Universal offers a broad range of sizes and types—assuring a model suited exactly to your needs. There are portable, stand-by and stationary models AC or DC, from 250 to 25,000 watts—1 to 6 cylinders. There is every type of control—manual to fully automatic.

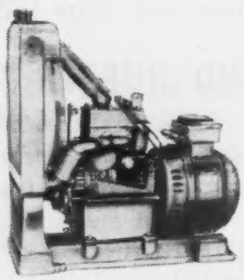
All Universals are of matched unit construction—with engine and generator exactly suited to each other . . . your assurance of long, reliable service.

Send for Booklet, "Electricity at Low Cost" for facts and photos of Universal Electric Plants.

Contractors and Representatives! Write for full details on the profitable Universal franchise.



Lightweight, easily carried—this Universal model provides 550 watts. Electric starting. Many other portable plants, all sizes, hand-carried, dolly, trailer, etc.

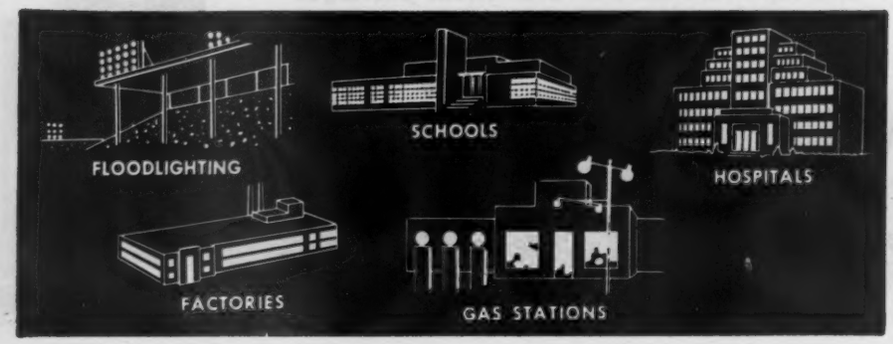


Universal 2500-3000 watt plant provides reliable, low-cost service. Powered by Universal 2-cylinder water-cooled engine. Other models to 25,000 watts.

UNIVERSAL MOTOR COMPANY

FOUNDED 1898

438 UNIVERSAL DRIVE · OSHKOSH, WISCONSIN



JOHNS-MANVILLE BUYS VAN CLEEF BROS.

Johns-Manville Corporation has announced the purchase of Van Cleef Bros., Inc., of Chicago, manufacturers of "Dutch Brand" industrial and automotive products.

The Chicago firm will be operated as a wholly owned subsidiary of Johns-Manville Corporation. No change is being made in the manufacturing, merchandising or distribution system of Van Cleef Bros., Inc.

The present personnel is being continued in the Van Cleef organization. Noah Van Cleef will remain as president and treasurer and his two brothers, Felix and Paul, will continue as vice presidents for sales and production, respectively.

J. L. HOWARTH NAMED G.S.M. OF ANDERSON BRASS WORKS

Anderson Brass Works, Inc. of Birmingham, Ala., has announced the appointment of J. L. Howarth as general sales manager.

Mr. Howarth, an electrical engineering graduate, started his carreer in the engineering department of the General

J. L. HOWARTH

Electric Company in 1924. He has been actively engaged in the electrical industry since then. During the past several years he has acted as general sales manager of Roller Smith, of Bethlehem, Pa., and Electric Power Equipment Corp. of Philadelphia.

WESTINGHOUSE CHANGES

The Board of Directors of the Westinghouse Electric International Company has elected Herman J. Mauderer as vice president and auditor. Arthur L. Partridge has been named assistant to the president and J. D. Mickle as manager of the import department.

Appointment of Alexander Martin as manager of the central district of the Sturtevant Division of Westinghouse Electric Corp., with offices in Pittsburgh, Pa. has

FOR FASTER SOLDERING 2 NEW WELLER SOLDERING GUNS with Solderlite

You can speed up and simplify the tough soldering jobs in electrical repair and maintenance work when you use the Weller Soldering gun with Solderlite.

Fast 5 second heating eliminates waiting time. Built-in spotlight finds the job faster, puts light right where you need it. Loop tip can get between wires; can be formed to get into corners.

Dual heat Model D-207 has 100/135 watts—enough heat to handle electrical maintenance jobs such as soldered connections encountered in motor rewinding, electrical and electronic control repair, instrument and meter work, etc.

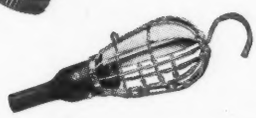
See your electrical wholesaler or radio parts jobber.

WELLER
MANUFACTURING CO.
815 Packer St., Easton, Pa.

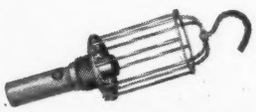
McGILL VAPORPROOF LAMP GUARDS

TRADE MARK

No 3005*



No. 8000-SR equipped with No-Rol cage of zinc plated wire. Polished wood handle with LEVOLIER* Switch. Lamp size — 40-100 W. (*T.M. Reg U.S. Pat. Off.)



No. 4675 uses polished wood handle with LEVOLIER* Switch. Cage of zinc plated heavy steel wire. Lamp size — 25-100 W (*T.M. Reg U.S. Pat. Off.)

No. 1440 Wall Guard for protection of bulbs exposed to theft and damage. Lamp size — 100 W

McGILL Adaptable Lamp Changers stop lamp changing hazards. Safety insulated. Convenient to use

TAKE PROTECTED LIGHT ANYWHERE *Safely*

Be sure of complete safety from fire and other disaster caused by a spark, heat or breakage of light bulbs with a McGILL Vaporproof Portable Guard.

Models designed for particular uses include such important features as brass or fibre cages, unbreakable moulded bakelite handles, heat and impact resistant globes. Completely air tight and waterproof.

Over a hundred other McGILL Lamp and Wall Guards available. Each built for a specific requirement of industry. They insure safe, convenient light anywhere it is needed — thereby increasing production efficiency.

*No. 3005 Vaporproof Guard has a heavy brass wire cage with sealed Insurok handle and air and moisture proof globe that is heat and impact resistant. Lamp size — 100 W.

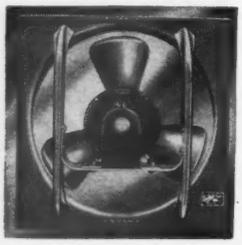
Send today for McGILL Catalog No. 43 so that you can pick out the lamp guard that will most effectively solve your own problems.

McGILL MANUFACTURING CO., INC.
Electrical Division
450 N. Campbell St., Valparaiso, Indiana

AIR EQUIPMENT TO HELP YOUR BUSINESS

JUST GIVE 'EM THE *Facts*
—*They'll Want*

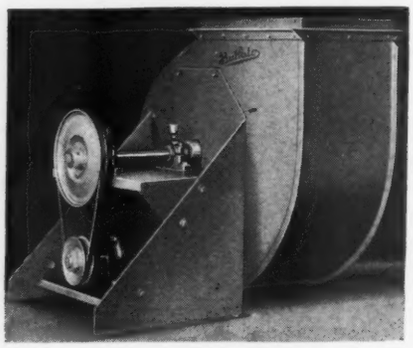
*BREEZO FANS



BUFFALO BREEZO FAN

No superlatives needed here in making worthwhile sales! Just tell customers that these husky fans can easily be installed in walls where needed—that they move a lot of air at a trifling cost—that they're heavy-duty to keep running years and years with no attention but lubrication! Square, die-shaped steel panel; rigid, welded-on arms; heavy-gauge, die-stamped blades; standard, first grade motors. Six sizes, 8" to 24".

*BELTED VENT SETS



BUFFALO BELTED VENT SET

Here are high-efficiency centrifugal fans that give store, theatre, shop ventilation installations a high degree of flexibility. Models available for indoor or outdoor installation. Rotors are dynamically balanced for vibrationless operation. RIGHT NOW is the time to get your facts on these quality-built "Buffalo" Fans—get lined up for the biggest ventilation year so far! Hundreds right in your territory waiting for you to TELL 'EM THE FACTS!

You'll Sell *More Ventilation* when you sell "Buffalo"—
Write for Data and Prices Now!

BUFFALO FORGE COMPANY

520 Broadway Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

FANS by Buffalo

EQUIPMENT		FOR
★ VENTILATING		★ FORCED DRAFT
★ HEATING		★ INDUCED DRAFT
★ COMFORT COOLING	★ AIR WASHING	★ PRESSURE BLOWING
★ PROCESS COOLING	★ EXHAUSTING	★ CLEANING
★ AIR TEMPERING	★ BLOWING	★ DRYING

CUTTING COSTS IN EVERY BRANCH OF INDUSTRY

been announced. He replaces Harold C. Hickock, who has resigned.

Kellen Wiles, of Needham, has been appointed executive assistant to G. C. Derry, general manager of the Sturtevant Division at Hyde Park, Mass.

E. M. Powell has been named middle Atlantic district manager of Sturtevant Division, with offices in Philadelphia.

Roger H. Martin has been appointed manager of the industrial department of Sturtevant. He succeeds Alexander Martin.

R. E. MURPHY ELECTED VICE PRESIDENT OF I-T-E

The I-T-E Circuit Breaker Company, Philadelphia, has announced the election of Roy E. Murphy to vice president in charge of sales. He will be in charge of I-T-E sales programs,

R. E. MURPHY

and coordinating the combined selling of I-T-E and its subsidiary, the Railway and Industrial Engineering Company, Greensburg, Pa.

Mr. Murphy has been associated with I-T-E since 1934, as sales manager and member of the Board of Directors. Prior to then he was sales manager for the Esterline-Angus Instrument Company, Indianapolis, from 1922 to 1932; and as operator of the Pittsburgh sales agency for that company, and other instrument manufacturers, from 1932 until 1934.

WAGNER ELECTRIC APPOINTMENTS

Wagner Electric Corporation has announced the appointment of M. E. Comstock as manager of its electrical division branch office in Boston.

The Tulsa sub-office has been transferred from the Houston branch office territory to the Kansas City branch office territory. H. M. Furtney is in charge of the Tulsa sub-office. A. W. Maas, formerly at Tulsa, has been transferred to the Philadelphia branch office.

Harry Anderson has joined the sales force of the company's Minneapolis branch office.

MERCOID

THE ONLY 100% MERCURY SWITCH EQUIPPED CONTROLS

1ST IN ··· QUALITY
ACCURACY
DURABILITY
PERFORMANCE
DEPENDABILITY
SAFETY FEATURES
EASY INSTALLATION
QUICK ADJUSTMENTS
SIMPLIFIED WIRING
UNFAILING SERVICE

DA Pressure Control

MERCOID CONTROLS

Give you the best in dependable performance. Have the longest control life and require the least service attention.

They regulate electrically operated equipment in accordance with changes in temperature, pressure, vacuum, fluid level or mechanical movement.

If you have a control or switch problem, let Mercoid engineers give you the benefit of their wide experience

Catalog Sent Upon Request

THE MERCOID CORPORATION
4235 Belmont Avenue, Chicago 41, Illinois

PARTS FOR FANS MOTORS CONTROLS

PROMPT SHIPMENT FROM LARGE STOCK

AUTHORIZED PARTS DISTRIBUTOR

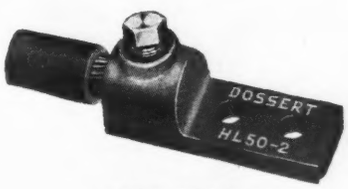
Brown-Brockmeyer	General Electric	Master
Century	Hamilton-Beach	Peerless
Cutler-Hammer	Holtzer-Cabot	Robbins & Myers
Delco	Howell	Star
Diehl	Hunter	Thor
Duro	Ilg	Wagner
Emerson	Leland	Westinghouse
	Marathon	

READING ELECTRIC COMPANY, INC.

Parts Distributors for the Manufacturer

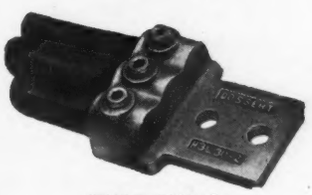
200 William St. ***Beekman 3-7800*** **New York 8, N. Y.**

TYPE HLH-1



TYPE HLH-2

TYPE H2L-2



TYPE H3L-2

DOSSERT CONNECTORS

--for your next power distribution job specify a--

DOSSERT HERCULON

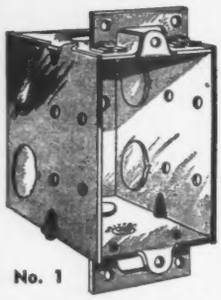
For guaranteed dependability and economy

Available for all sizes and combinations of standard size cables or wire. For further information send for our Catalog 45-2 which also lists other modifications of the Herculon connector.

"Insist on Genuine Dosserts"

DOSSERT MFG. CORP.
249-255 HURON STREET, BROOKLYN 22, N. Y.
SINCE 1904

Electric Switch and Outlet Boxes
Available for Immediate Shipment



No. 1

2¾" deep, ½" knockouts, ears attached.

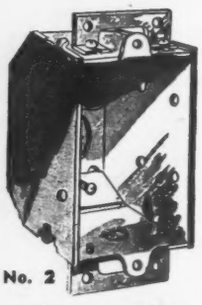
Aluminum electric switch and outlet boxes . . . approved by Underwriters Laboratories, Inc., Chicago, and REA.

Immediate Delivery of any quantity desired. All boxes guaranteed against defective workmanship or material. Check these features:

- Precision made. Die stamped, press formed from .091 gauge sheet aluminum. Conform to all building codes and requirements.
- Longer lasting—rust & acid resistant.
- Light weight—easy to handle, inexpensive to ship.
- Sturdy construction—will not bend or break.
- Easy knockouts.

No. 3

2" deep, ½" knockouts, ears attached.

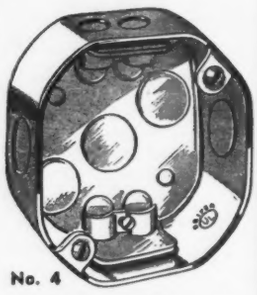


No. 2

2¼" deep, romex clamps, ears attached.

See your jobber today. If he cannot supply you write direct.

W. T. DRIVER,
Manufacturer
2650 37th Ave. So., Mpls. 6, Minn.



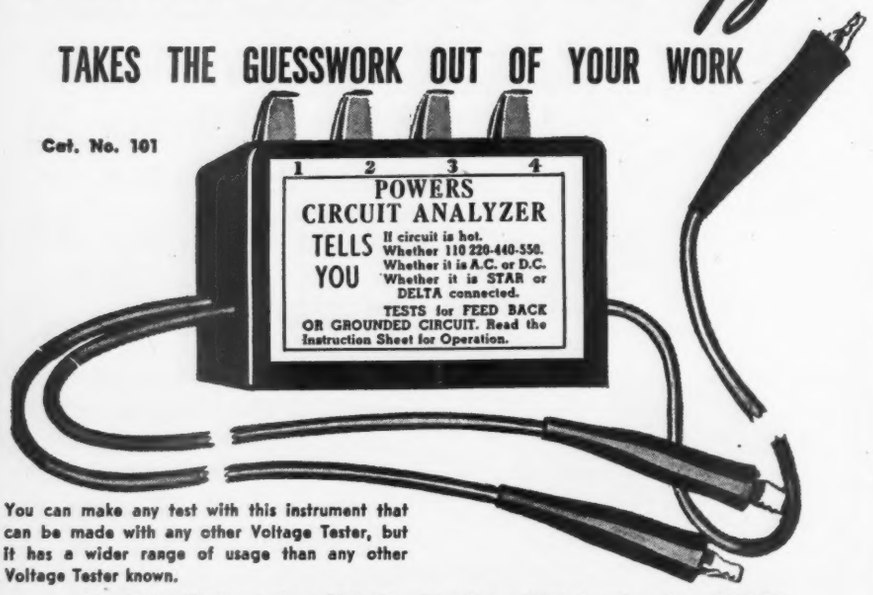
No. 4

4" Octagon, 1½" deep, three ½" knockouts and 4 loom knockouts in bottom, with clamps. Two ½" knockouts and 4 loom knockouts in sides. One piece draw. Also available with all ½" knockouts.

Powers Circuit Analyzer

TAKES THE GUESSWORK OUT OF YOUR WORK

Cat. No. 101


1 2 3 4
POWERS
CIRCUIT ANALYZER
TELLS YOU
If circuit is hot.
Whether 110 220-440-550.
Whether it is A.C. or D.C.
Whether it is STAR or DELTA connected.
TESTS for FEED BACK OR GROUNDED CIRCUIT. Read the Instruction Sheet for Operation.

You can make any test with this instrument that can be made with any other Voltage Tester, but it has a wider range of usage than any other Voltage Tester known.

List Price Without Case $14.40 List Price With Leather Case $24.50

Approx. Dimensions 6" x 4" x 1½"

POWERS Products are sold through most all Electrical Distributors BUT if your local Distributor cannot supply you please write to factory for illustrated Bulletin and Descriptive matter.

POWERS MANUFACTURING COMPANY

1527 Folsom Street San Francisco, California

Makers of Practical Equipment for use by Practical Men

The Frank Adam Electric Company of St. Louis, Mo. has consolidated two districts, Toledo and Cleveland, into one district under the direction of Gordon F. Stofer, 801 Caxton Building, Cleveland, Ohio.

Charles F. Kraut has been appointed electrical engineer in the New York office.

•

The Mitchell Manufacturing Company of Chicago has announced the appointment of Irving S. Warner as district sales manager for the states of Virginia, North Carolina and South Carolina. He replaces the former representative Walter Nelson.

•

Bob Kempton is now associated with **All-Steel Equipment, Inc.** of Aurora, Ill. He will be responsible for more closely coordinating field distribution with the home office policies. Mr. Kempton was formerly with Edwards & Co.

•

Alfred D. Pool has been appointed manager of electric motor sales in the midwest and east for the **A. O. Smith Corporation** of Milwaukee, Wis. His headquarters are in the company's Chicago district office.

•

Ward Leonard Electric Co., Mt. Vernon, N. Y. has opened a New England office at 37 Webster Street, Hartford, Conn. C. F. Shea, formerly with the home office sales engineering department, is district manager.

•

Sterling Electric Motors of Los Angeles, has recently opened an office at 1836 Euclid Avenue, Cleveland, Ohio. J. W. Rickett is in charge of the new office.

•

The Weston Electrical Instrument Corporation is now occupying its new engineering and administration building on the plant grounds at Newark, N. J.

•

E. E. Ellis has been named engineer-in-charge of sales, motor and generator section of the **Allis-Chalmers** electrical department.

•

Robert B. Franklin has been appointed manager of the **Ipswich, Mass. fixture** plant of **Sylvania Electric Products, Inc.**

•

Automatic Temperature Control Co., Inc. has moved to new and larger quarters at 5212 Pulaski Avenue, Philadelphia, Pa.

Save Money and Time with

SYNTRON

DEPENDABLE

ELECTRIC HAMMERS

3600 Powerful, Hard-Hitting Blows per Minute Speed Up—

Drilling—Cutting—Chipping in concrete and masonry

SYNTRON'S patented electromagnetic principle uses only one working part—the PISTON—producing high speed, hard-hitting blows that cut down job time.

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SYNTRON CO.

690 Lexington, Homer City, Pa.

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INDUSTRIAL

LIGHTING EQUIPMENT

for Better Profits and More Installations

● Take on more of those re-modeling jobs—more new and replacement installations—select the proper units from the MULTI line. Industrial plants, shops, factories—they are all converting to the most modern, efficient lighting available . . . MULTI Units have individual construction features that make them adaptable to the particular job. We can supply what you want immediately.

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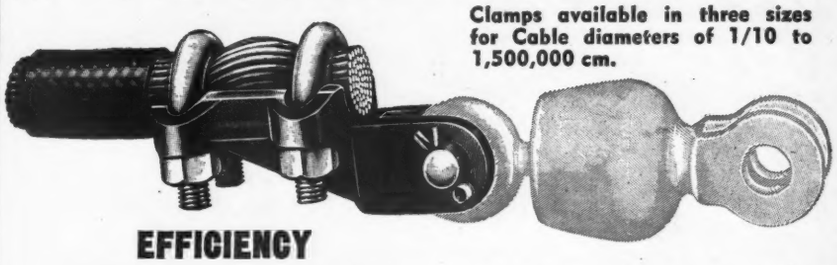
MULTI ELECTRICAL MANUFACTURING CO.

4223 W. Lake Street **Chicago 24, Illinois**

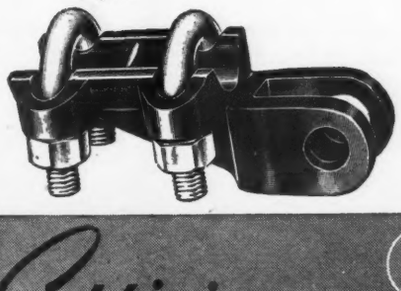
"EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION



Clamps available in three sizes for Cable diameters of 1/10 to 1,500,000 cm.

EFFICIENCY CABLE STRAIN-CLAMP

. . . Stands *Direct Pull* of over 17,000 lbs. before cable slips!



By actual test, the EFFICIENCY Cable Strain Clamp will withstand a direct pull of over 17,000 pounds without permitting the cable to slip. This powerful grip results from the EFFICIENCY Clamp's "H" design, incorporating a high ridge across the center of the cable channel and a U-bolt at each end.

Adapability to all requirements is provided in the EFFICIENCY Clamp's alternate construction . . . which may be clevis or eye, according to your requirements. Both styles are furnished for A.C. or D.C. service.

Write today for your copy of EFFICIENCY Catalog No. 38A . . . contains complete construction and application data on all EFFICIENCY Devices.

Efficiency ELECTRIC AND MANUFACTURING CO.

MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT, WIRE AND CABLE SUSPENSION

EAST ROCHESTER, OHIO

New HEAVY-DUTY ELECTRIC PLANT

5000 WATTS

Only 272 lbs!

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$545.00
FOB MINNEAPOLIS

• Large capacity, compact design, and lightweight aluminum construction are combined in this new, rugged, portable electric plant. Easily carried by two men. Powered by Onan 10 HP horizontally-opposed, two-cylinder, 4-cycle, air-cooled engine. Unusual operating economy. Shipped complete, equipped with four-receptacle outlet box and mounted in tubular-steel guard frame.

NEW ONAN CK ELECTRIC PLANTS are available in 5,000 Watts D.C., 115 and 230 volts; 2000 and 3000 Watts A.C. in all standard voltages.

ONAN ELECTRIC PLANTS—A.C.: 350 to 35,000 Watts in all standard voltages and frequencies. D.C.: 600 to 15,000 Watts, 115 and 230 Volts. Battery Chargers: 500 to 6,000 Watts, 6, 12, 32 and 115 Volts.

ONAN AIR-COOLED ENGINES—CK: 2-cylinder opposed, 10 HP. BH: 2-cylinder opposed, 5.5 HP. IB: 1-cylinder, 3.25 HP.

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DO YOU REPAIR ELECTRIC MOTORS?

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HARCO EQUIPMENT CO.

2473 SHERMAN AVE., N.W., WASHINGTON 1, D. C.

DRAFTING ROOM LIGHTING TECHNIQUES

[FROM PAGE 61]

utility company. In this job, 20-inch wide glass panels were installed on two-foot centers, with one edge raised about six inches above the other. This takes the glass panel out of the normal field of view. Acoustical tile panels, painted salmon pink, were installed in a nearly vertical position between the raised edge of the glass panels and the effective ceiling line. This opaque tile surface is all that remains visible in the normal field of view of the draftsman. A single fluorescent lamp is installed in a 20-inch wide sprayed aluminum finish reflector above the diffusing glass panel, which provides a uniform light intensity over the diffusing glass. Initial lighting intensity was 86 footcandles, with a load of six watts per square foot. Ceiling brightness in this installation is comfortable, and shadows are reduced to a minimum. The lighting is direct in character, affording ample specular reflection for quick vision of fine detail having poor contrast, yet comfortable since the footcandle intensity is high enough to prevent annoyance of reflected glare.

When vertical drawing boards are used, specular reflections and shadows from T squares, triangles, scales, etc., are practically eliminated, and standard layouts of standard lighting systems which provide good diffusion are usually satisfactory.

The indirect-plus-direct lighting technique (illustrated) has considerable merit, and has proved satisfactory in use. The installation shown in the picture consists of one complete indirect lighting system, supplemented with one complete direct lighting system. Each system uses fluorescent lamps. In the indirect system, continuous-row indirect troughs using 2/100-watt lamps per five-foot length are suspended 24 inches from the ceiling. The continuous-row indirect troughs are spaced eight feet apart. The direct lighting units are located on eight foot centers, and installed on the ceiling midway between the indirect units. The direct lighting luminaires are continuous-row type, with a single 40-watt lamp enclosed in a half-round diffusing glass shield each four feet of length. The intensity is about 70 footcandles maintained, with approximately two-thirds of the intensity being indirect. The indirect troughs completely shield the direct lighting units in the normal field of view. The direct lighting units provide ample directional component

You can start this Improvement **RIGHT NOW!**

CHANGE BOXES INSTANTLY—

without disturbing conduit. Only with Kondu can you take one fitting out of the line and slip another in its place—*because every Kondu fitting is a union.*

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of Conduit Lines or Portable Equipment . . . Kondu Fittings are made of high-aluminum Konduloy, and give you *greater strength* with *two-thirds less weight.*

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every time—Kondu line includes one that's exactly suited. And every Kondu Fitting is vibration-proof . . . Practically unbreakable . . . 100% reusable. Write for the Kondu Catalog.

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FAST—SELLING *DependABle* REFLECTORS

ABolite Reflectors and floodlights are recognized throughout the lighting field for flawless construction, durability, ease of installation and maintenance. With designs and shapes to conform to RLM standards and every lighting requirement, these reflectors have thousands of applications in industry for factory, yard, playground, protective and sign lighting.

Made of finest quality porcelain on steel, ABolite reflectors are easy to clean and provide efficient and economical lighting. Complete line includes all types of popular reflector shapes designed for every kind of installation.

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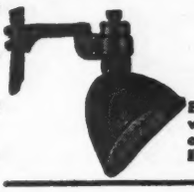
PORCELAIN ON STEEL

RLM STANDARD DOME
Separable socket. Also made in threaded neck, heel neck and Duo-move.

DEEP BOWL
Formed neck type. Threaded and heel neck, quick detachable and Duo-move types also available.



OPEN TYPE FLOODLIGHT
Elliptical angle. Made with brackets for either open or concealed wiring. Easily adjustable.

SIGN REFLECTOR
Wide-spread angle type. Also made in elliptical, rectangular and symmetrical angle.

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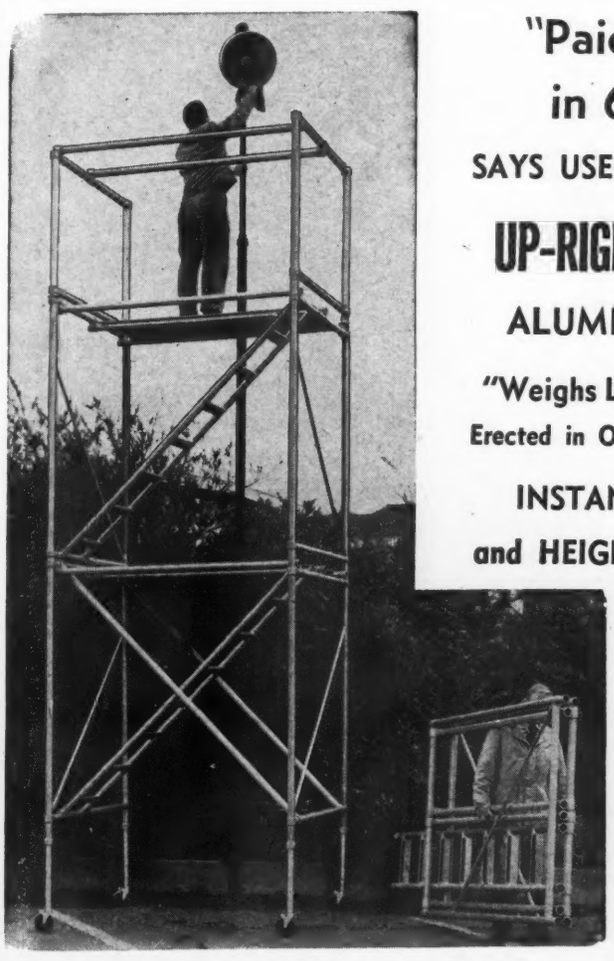
THE JONES METAL PRODUCTS CO., West Lafayette, Ohio



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Easier,

FASTER MOUNTING!

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MOUNTING DIRECTIONS:

1 Drive screws all the way into threaded clamps
2 Set screws against threaded openings in outlet box
3 Back screws off until receptacle is flush with wall
4 Drive screws solidly home

Clamps adjustable for lateral movement

REVOLUTIONARY NEW
SPEEDMOUNT
"500"
DISTANCE VARIABLE BY SIMPLE ADJUSTMENT WITH SCREW DRIVER
SCREW LOCKS TIGHT AGAINST THREADED SIDE OF CLAMP
PROFILE VIEW OF RECEPTACLE MOUNTED ON BOX

THE SPEEDMOUNT "500" PAYS FOR ITSELF

No more fuss with washers or broken plates—the Speedmount "500", with its ingenious clamps, enables a jiffy-quick installation tailor-made to insure mounting of receptacles flush with wall or baseboard, when outlet boxes are installed too deeply or not lined up properly.

Speedmount "500" will practically pay for itself in the time saved by faster mounting and the elimination of service calls.

Available in Brown or Ivory

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Belco PRODUCT

BELL ELECTRIC COMPANY
CHICAGO 8 ILLINOIS

to give form due to the soft shadow effect, and also add a desirable small component of specular reflection. The total light intensity is adequate to prevent discomfort from the specular reflection present, or annoyance from the soft shadows created.

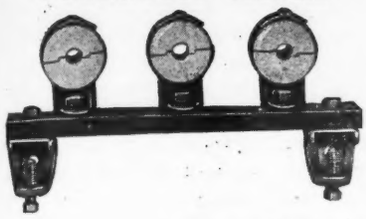
Drafting rooms are sometimes located in open areas having roof-truss or mill-type construction. In such areas indirect lighting is of course impractical. For such cases, it is practical to install localized general direct lighting, using large area low surface brightness units with the lamps adequately shielded. Also illustrated is another solution suitable for this problem, in which two standard industrial type reflectors are used over each board, and so installed that one unit is at the end of, and at the right angle to, the other unit.

The new louver-all ceiling principle offers a lighting technique which should prove entirely satisfactory and practical for lighting drafting room areas. The louvers should be spaced fairly close together to provide approximately 45-degree shielding in all directions. Louvers may be of plastic, metal or wood, and light in color. The 40-watt 60-inch low brightness fluorescent lamps provide an ideal light source for installation above the louvers. These may be installed either in reflectors, or on wiring channel when the entire area above the louvers is painted flat white. Such installations should be designed for intensities of 50 footcandles or greater, maintained in service, so that specular reflections will not be apparent or annoying.

Many draftsmen express the need for local lighting on their drawing boards, such as that provided by an adjustable arm reflector type unit. Suitable units are made for both incandescent and fluorescent lamps. This desire on the part of the draftsman springs primarily from the need for more light, and usually occurs where draftsmen are working in rooms with low intensities of general illumination, and with poor or improper location of the general lighting units. Lighting men generally agree that local lighting of this type introduces excessive brightness contrast and glare. It does, however, provide enough light for the draftsman to see fine detail. He usually eliminates annoying specular reflection by adjusting the location of the reflector and direction of the light from the reflector. When adequate general lighting of proper comfort cannot be provided, and the draftsman wants a local lighting unit, it should be provided for him.

NEW!

Non-Inductive Conductor Racks



Racks available for any number of cables—cable sizes 5/16" to 2⅝".

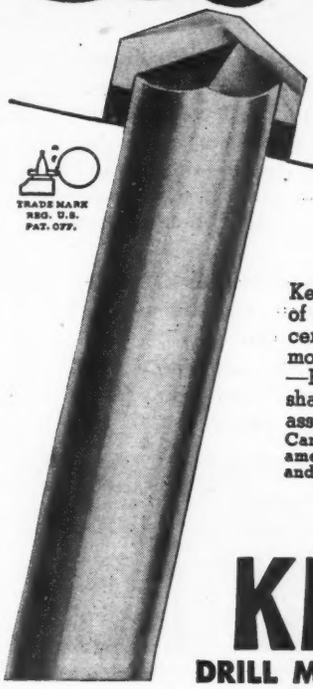
● Available in types for any number of cable, the M & W Types S-L Conductor Rack is designed so that cables are only partially surrounded by metal. This prevents induced current—permits the rack to be used for A.C. or D.C. systems. Simple design makes for quick, easy mounting of cables.

Write today for Bulletin C-5-51 . . . contains full information on M & W Non-inductive Cable and Conductor Racks.

M. & W.
ELECTRIC MFG. CO.
EAST PALESTINE OHIO

DRILLING COSTS DROP

BECAUSE THE CUTTING EDGE is KENNAMETAL



TRADE MARK REG. U.S. PAT. OFF.

Kennadrills save time and labor drilling holes in all types of masonry—because their cutting edge is Kennametal cemented carbide—the metal that is far harder and more durable than tool steel. No starting punch needed—Kennametal tip takes hold readily, drills fast, stays sharp under heat and abrasion of cutting. Design assures clean, accurate drilling.

Can be used in any rotary drill. Available in following diameters: ¼", 5/16", ⅜", ½", ⅝", ¾", ⅞", 1", 1⅛", 1¼", and 1⅜".

Distributors Wanted

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Sherman "Wedge-Grips" insure strong, lasting wire connections. Oval pointed screw wedges the wires together under pressure, between special "V"-shaped corrugations. Dependable, permanent — of pure, hard-drawn copper — they are ideal for all small wire connections.

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VOLTS • AMPERES
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FEATURES:

★ Completely portable—No external source of current required.

★ Individual binding posts for each range reduces to absolute minimum the possibility of damaging meter.

★ Uses 4½" square rugged meter with large easy-to-read type.

★ All calibrations printed directly on meter.

The Model 247 comes housed complete in a beautiful hand-rubbed Oak Cabinet with removable hinged cover.

SPECIFICATIONS:

A. C. Voltage Ranges—
0 to 150/300/750 volts.

A. C. Current Ranges—
0 to 3/7.5/15/30 amperes.

Resistance—
0 to 20,000 ohms.

Watts*—
0 to 300/750/1500/3000 watts—
115v. line
0 to 600/1500/3000/6000 watts—
230v. line

*Watts computed on the basis of Unity Power Factor.

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A precision built instrument of established merit incorporating the following features—starting reliability coupled up with a fully automatic circuit breaker that will cut out a deactivated tube from the circuit—no manual reset required to allow starter to perform all of the lamp starting functions when a good lamp is installed. Contacts are made of noble metal assuring longevity, durability and economy.

You'll find Industrial Electronics Corporation products in factories, office buildings, stores, railroad terminals, shipyards, schoolrooms . . . everywhere contributing to the comforts of American Life.

The (SP-15-20) for use with either 15 or 20 watt lamps
The (SP-30-40) for use with either 30 or 40 watt lamps
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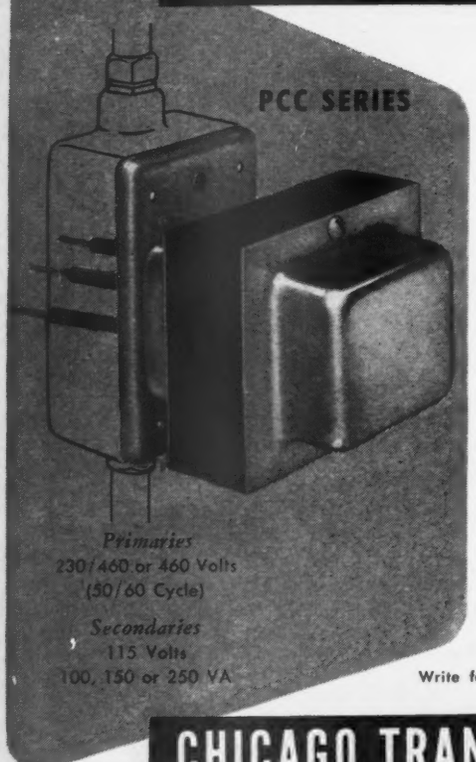

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Eliminate unnecessary runs of 115-volt wiring to machine tools, welders, and other production equipment. Install these versatile transformers on the same 220 or 440-volt power line used for machine operation, and supply lighting and other 115-volt requirements up to 250 VA (continuous duty) with economy.

- *Simple, convenient to mount—will fit on any FD or FS-type conduit box.*
- *Secondaries fused for overload protection.*
- *High quality core and coil construction for long and dependable operating life.*
- *Durable cadmium plated finish on shields and cover.*

Write for prices and further details.

CHICAGO TRANSFORMER
Division of Essex Wire Corporation
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WIRING REVAMPED FOR RESEARCH

[FROM PAGE 51]

mal daytime intensities average 60 footcandles or better.

Much of the original lighting wiring could be retained, although new circuits were run parallel to the old to supply additional capacity where necessary and to increase the flexibility of control. In some locations, existing panelboards contained spare circuits and could be retained to control the old as well as some of the new circuits.

Replacing incandescent fixtures in laboratory areas with fluorescent units resulted in a major increase in light output without adding materially to the load on the wiring already installed. However, due to the addition of an intermediate floor in the gymnasium, creation of additional rooms, shifting of partitions, reallocation of space, establishing new multiple-voltage receptacle circuits and connection of the many motors required for special equipment, the existing distribution system was expanded by 46 new panelboards serving 477 circuits.

While 480 volt a-c is available for pilot plant operation and for heavy duty equipment, laboratory circuits (for lighting, for feeding bench and floor receptacles, and for the operation of most of the special equipment) are primarily 208/120 volts. Voltages other than 480, 208 and 120 are supplied through a specially designed, centrally located switchboard delivering a-c at any desired level from zero to 135 volts, and d-c from 2 to 40 volts in two-volt steps. Including the various fixed-voltage receptacles, laboratories are served by a total of 14 utilities. Among these other services are hot, cold and distilled water, steam, brine, compressed air, vacuum and gas.

Operating on 208/120-volt a-c is such special equipment as an infra-red spectrometer, spectrophotometer, spectrograph, speedomax recorder, X-ray diffraction unit, microdensitometer, electron microscope, ultra-violet color fadeometer and a film testing machine.

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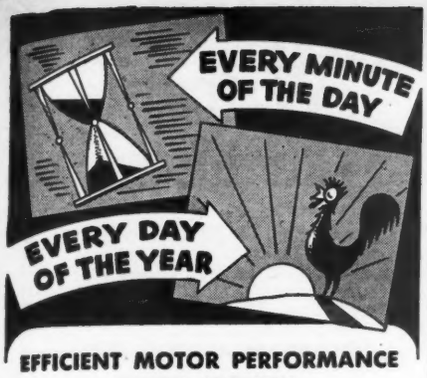
With an efficient distribution system serving the electrical needs of laboratories and small scale pilot plants housed in this modern building, basic exploratory research is developing new products and improving present procedures and processes in the interest of increased quality at reduced costs.



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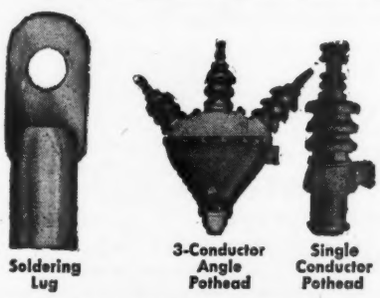

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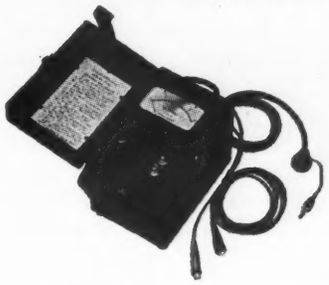

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Two indicator lights discriminate between breakdown and leakage. Direct ratio between applied voltage and insulation leakage resistance—accurately calibrated meter in secondary reads actual voltage applied—output voltage unaffected even with load equivalent to ¼ megohm across terminals—range 0-4000 volts continuously variable from 0 to maximum—shielded high voltage leads—grounding clip at end of line cord. Sturdy metal case makes instrument readily portable. These and many other features are described fully in bulletin No. 302.

Also available: "Vibrotest" insulation resistance tester—"Vibroground" ground resistance tester—cable fault locators—soil resistivity meters—limits bridge—ammeters—ohmmeters—current transformers.

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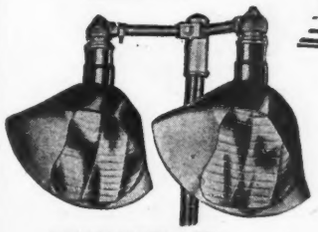
POST TOP OR PUMP REFLECTORS



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BLACKHAWK
PIPE BENDER

Blackhawk Benders do MORE than bend pipe. They include a Porto-Power Hydraulic Unit that performs this triple job:

1 PIPE BENDING
Bends rigid conduit and pipe of all popular diameters. Saves need for elbows, couplings and extra cutting and threading.

2 MAINTENANCE and PRODUCTION
Porto-Power pushes, pulls, bends, presses, spreads, and clamps—pulls gears, lifts machinery and licks scores of other jobs.

3 SPECIAL JACK
Compact Hydraulic Ram works in all directions — at any angle. A versatile, safe, remotely controlled jack.

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BLACKHAWK
WORLD'S LARGEST MANUFACTURER OF HYDRAULIC JACKS

VOLUME DURATION STUDIES

[FROM PAGE 65]

from previous studies that the material cost was a minor item on extended duration projects. It should be less, in proportion, for prolonged duration.

Tables (or curves) can be in percentages of labor with an allowance included for material service. With the material allowances based on a M/L ratio equal to 60/40, the curves will serve for practically all jobs. The exceptions being where there is a predominance of material.

Chart IV furnishes another illustration of Labor versus Material costs. The following items provide some comparisons between "Complete" and "Installation Only" projects:

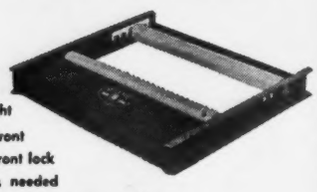
Sell Prices	Types of Installation	Cost per Month Ext. Time
$100,000	Complete installation	$1,420.
100,000	Installation-Only Project	2,300
200,000	Complete installation	2,000
200,000	Installation-Only Project	3,350

This concludes the series on "Volume-Duration" Studies.

TO REEL OR UNREEL THE EASIEST WAY

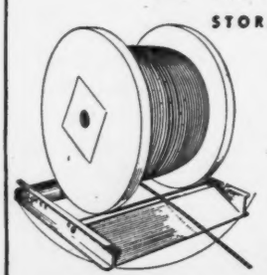
WHATEVER YOU USE ON A REEL . . .
WIRE, CABLE OR ROPE. SAVE TIME AND LABOR WITH

ROLL-A-REEL



Portable
Lightweight
Slanted front
Positive front lock
No jacks needed
Adjustable slots for many widths

TAKE IT TO REEL, STORAGE OR JOB



Style A:
2,000 lbs. cap.
37.50

Style B:
4,000 lbs. cap.
75.00
f. o. b. Cincinnati

ASK FOR DETAILS — IMMEDIATE DELIVERY

ROLL-A-REEL
327 WEST FOURTH STREET
CINCINNATI 2 OHIO

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Equipment, Materials, Supplies and Services for Electrical Construction — Maintenance—Repairs

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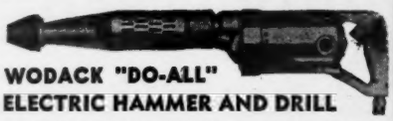

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Saves time and labor installing expansion anchors. Two motions—reciprocal for hammer drilling—rotary for twist drilling. Drills masonry to 1⅜" dia., metal ⅝". Easy to maintain. Universal motor, runs direct from lamp socket. Weighs 15 lbs. Star drills in 17 diameters. Also chisels, bull points, etc. Ask for Bulletin 442 EC.

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WITH OR WITHOUT
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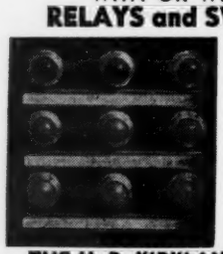

A typical assembly made with Type 590 Units, one of many Kirkland Types available.

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Morris Street Morristown, N. J.

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This
WHERE TO BUY
Section

supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation in the electrical construction industry. Make a habit of checking this page, each issue.

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